The Electrical Industry's Weekly Magazine December 26, 1960

Electrical World

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REVIEW OF 1960

1961 PREVIEW

...page 55

DRESDEN EXPERIENCE SHOWS BWR POTENTIAL . . . p 50

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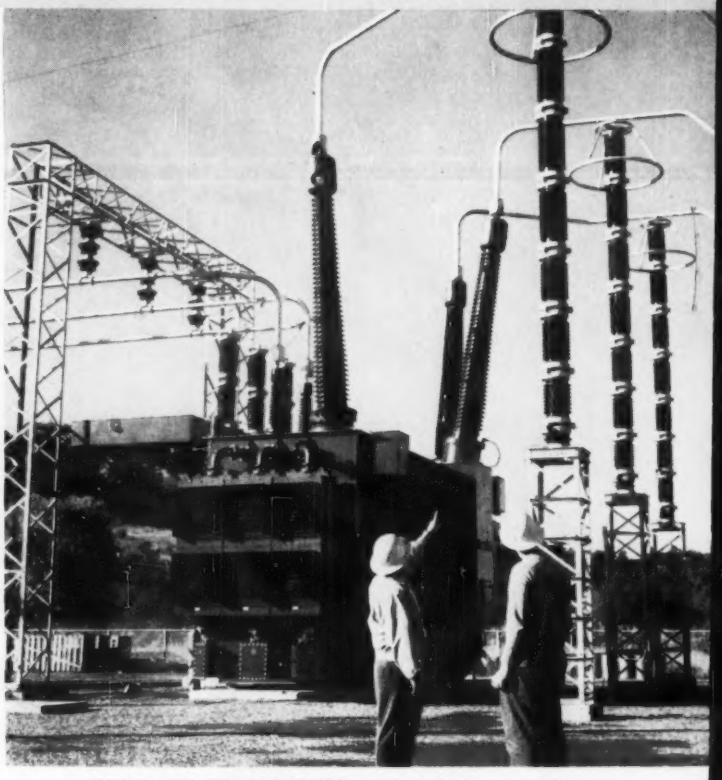
General Electric reports on developments in . . . TRANSMISSION

PENELEC BEGINS 460-KV TRANSMISSION

General Electric equipment and Project EHV experience utilized in new line



460-KV G-E TRANSFORMER and lightning arresters are shown here at Penelec's Claysburg Station.

ON SEPTEMBER 30, 1960, a switch was closed at Pennsylvania Electric Company's Claysburg Station in south-central Pennsylvania, and a new 13-mile extra-high-voltage transmission line was energized at 460 kv. This is the first 460-kv line in the United States to carry full voltage as part of an established transmission grid. Experience with the new line will help electric utilities to solve the problems involved in transmitting larger blocks of power over longer distances.

GENERAL ELECTRIC and eleven other manufacturers supplied equipment for the line. G-E equipment includes the highest voltage 3-phase power transformer in utility service in the United States (460-kv, 60-mva), lightning arresters, disconnect switches, supervisory and relaying equipment, and line hardware.

PREPARATORY RESEARCH for Project EHV—a super-voltage system being built for test purposes near G.E.'s Power Transformer Department in Pittsfield, Massachusetts—enabled the Company to provide planning assistance to Penelec:

- A special computer program was used to predict radio influence levels.
- Geometric tower and line models were tested to study lightning response.

LIGHTNING FIELD STUDIES will be conducted jointly by Penelec and General Electric during the next several summers. Engineers will use oscillographs, cameras, and other instruments in a special mountain-top trailer, plus magnetic links and 35 line-surge oscillographs along the line, to obtain information on lightning strokes and currents. The goal: greater knowledge of lightning and of line outage rates.

TWO ENGINEERS, S. J. Polaski of Penelec and D. J. Heller of General Electric, will measure and photograph lightning from this mountain-top trailer.

SIX OTHER UTILITIES investigating super-voltage transmission have also benefited from General Electric's Project EHV research. To learn how Project EHV can help you, see your G-E Sales Engineer or write to Section 604-12, General Electric Co., Schenectady 5, New York.

MORE POWER TO AMERICA

GENERAL ELECTRIC

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

DECEMBER 26, 1960
Vol. 154, No. 26

What in the *Electrical* World . . .

It has been our privilege during the holiday season to reproduce in our pages some particularly appropriate sentiment expressed by an electric utility. This year we borrow from an advertisement created by the Indiana & Michigan Electric Co, and express our appreciation to I&M for permitting its use.

Christmas is many things. It is the biggest thing there is and a lot of little things, too. It is festive and sober, ancient yet always new. Christmas means reunion and communion with one's own. Still it is not Christmas, really, unless there is a reaching out also to all men everywhere. It is personal yet universal. You can see Christmas in the sparkle of youthful eyes, in the mist of older ones. You can hear it in gay carols and in sermons and in prayers. You can sense it in a thousand ways. You can do just about everything with Christmas but put it into words, for Christmas stems not from tongue or pen but from the heart. From the heart then— and taking thought for all the many things that Christmas is—may we extend our fervent hope that yours will be a reflective and a very joyous one.

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SET POLES FAST... with LESS LABOR

Series PM-20

"Pole-Master"

Hydraulic Derrick

Whether you're pulling or setting poles, hanging transformers or doing other precise hoisting, the double-action hydraulic cylinders of the redesigned PM-20 Derrick will do the job up to 40% faster ... with less manpower. This new torture-tested, heavy-duty derrick withstands extreme lateral strains ... weighs less, yet lifts up to 5 tons ... body loads up to 2,500 lbs. ... operates through an arc exceeding 200 degrees from stored position to within 18″ of the ground ... does not creep or "kick-back" under load ... and provides sufficient down pressure to dig fast, clean holes.

The PM-20 is available in three standard sizes to handle 40′, 55′ and 70′ poles. An optional hydraulic or manually operated head sheave extends 56″ to increase the reach to 25½′, 29′ and 34′ for hoisting 50′, 65′ and 80′ poles.

POWERS American

Frame-guided EM-2 Digger installed on PM-20 Derrick digs holes ... vertically or at angles ... from 9″ to 30″ in diameter and up to 10½′ in depth.

Series PM-10 Hydraulic Derrick digs, lifts and loads ... exceeding most rigid utility requirements.

Series PM-30 Oscillating Hydraulic Derrick corner mounts. Digs, hoists to rear or either side of parallel parked truck.

Both derricks lift up to 4 tons; arc in excess of 200 degrees; handle 40′, 50′ and 70′ poles; body load up to 2500 lbs.; exert down pressure for digging. Extendible hydraulic head sheave optional with PM-10 and standard with PM-30-55 and 70.

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Electrical World

Letters

'Systemation' Is Service Mark

To the Editor:

We read with interest your report in the Nov. 21 issue of *Electrical World* regarding plant automation in this country and Europe. It is stated in this report that Gulf States Utilities Co is the first power company to apply computer control to a peaking plant through installation of its "Systemation" project at the Riverside Power Station.

It should be pointed out that "Systemation" is an Allis-Chalmers registered service mark and covers the entire plant operating and control systems. Under our prime contract, the electronics portion of this project for the plant performance analysis and control system will be engineered and furnished by Consolidated Systems Corp, an associate company of Allis-Chalmers and Bell & Howell.

A clarification of these points would be appreciated.

W. E. Korsan, Assistant Manager
Industrial Systems Department
Allis-Chalmers Manufacturing Co

Co-op Position Is Given

To the Editor:

It was good to see *Electrical World* tell their position on non-investor-owned power (EW, Nov. 7, p 75). Heretofore, I have always mentioned *Electrical World* as "slanted" toward private power. Your item in the current issue means no more use of the word "slanted!"

It is best that all positions be clarified. While I cannot put it in words so well, the position of a manager of an average, for Tennessee, member-owned electric operation may be of interest to you. For 18 years as manager here, these give our position:

The minimum billing for residential with us, regardless of location if in our service area and regardless of the cost to serve, is 75¢ minimum, signed for one (1) month only—although we hope for continued full use. This is area coverage.

Taking service to every applicant in our service

(*Continued on page* 98)

Dateline . . .

San Francisco—Experts outside and inside the Atomic Energy Commission are focusing seriously on the question: Should the Commission, which has brought the art up from an elementary bomb, to a fledgling industry, be reorganized to handle the complicated problems of a regulated industry?

There are those who say the reorganization must come quickly, and that some functions of the Commission must be spread into other or even new agencies of government.

There are others who believe that the overhaul can be done inside the headquarters at Germantown; that functions can be divided so that the five-man Commission will not, in emphasizing one of its responsibilities (say, promoting atomic development) fail to discharge an equally important function (say, insisting on strictest safety requirements for atomic industry.)

The need for a searching inquiry into the present status of the Commission, and its future, became a dominant theme of the recent annual conference of the Atomic Industrial Forum and the American Nuclear Society here. In formal and informal discussion, the major query was how free enterprise industry under AEC regulation can reasonably and expeditiously grow.

AEC, in the development and use of nuclear energy, is supposed to contribute to national defense and economic growth, to secure the health and safety of US, citizens and to strengthen free competition.

AEC's organization and the way its regulatory system functions presents a series of different faces to industry.

The Commission's functions are divided into three categories: operational, promotional and regulatory.

Roughly, the operational function stems from AEC's responsibility under the Atomic Energy Act

(*Continued on page* 48)

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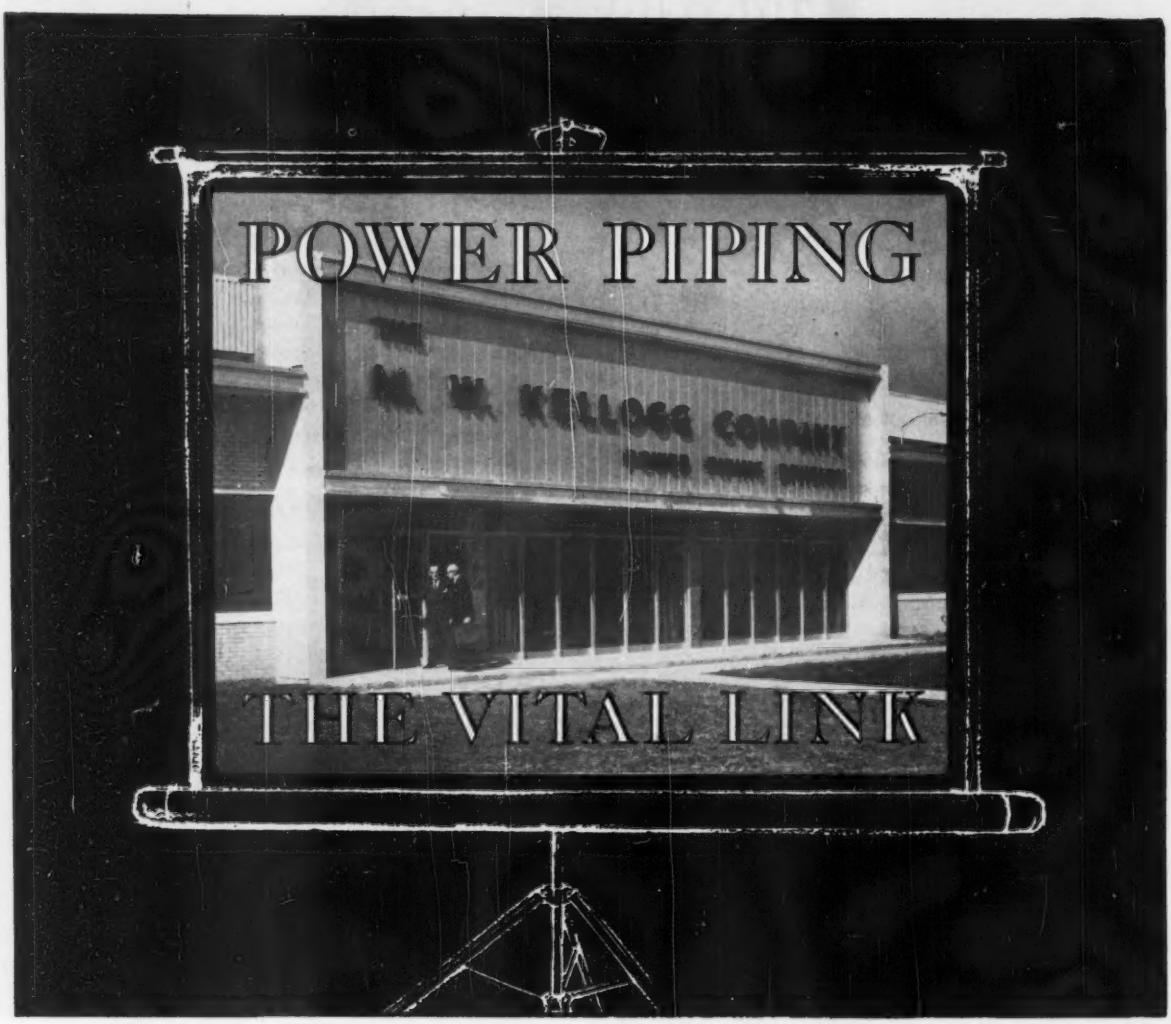

NEW FILM shows how quality power piping helps the nation live better electrically

Just produced by The M. W. Kellogg Company, and available January 1, 1961, this sound-color film on power piping is valuable viewing for utility managements, engineers, and others concerned with the generation of electric power. Explaining in full the subject of power piping, "The Vital Link" also provides an interesting education for users of electricity.

Showing what power piping is, does, and how it is made and erected, and its importance to the utility industry, this new film takes you first into the central station of a large electric utility. It then guides you through Kellogg's new plant at Williamsport, Pennsylvania—the most modern ever designed specifically to manufacture power piping for electric utilities.

In Williamsport, you will follow the many manufacturing steps necessary to assure the highest quality product from the time the raw materials arrive in the plant until finished assemblies are shipped. The final step—field erection in a customer's plant—shows the importance of sustaining quality work to insure efficient production of electricity.

For arrangements to view "The Vital Link" in your own offices or at outside meetings, contact the nearest office of Kellogg's film distributor:

MODERN TALKING PICTURE SERVICE INC.
Three East 54th Street, New York, N.Y.

POWER PIPING DIVISION • THE M. W. KELLOGG COMPANY
Plant & Headquarters: Williamsport, Pa. *Sales Offices:* 711 Third Ave., New York, N.Y.
A SUBSIDIARY OF PULLMAN INCORPORATED
Offices of other Kellogg companies: Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires

You can save money on line maintenance with Graybar as your auxiliary warehouse

Need wire cutters? Pin type insulators? Guy strand? An electric impact wrench? Whether for day-to-day use or emergencies, Graybar can deliver everything you need for line maintenance — from eye bolts to completely pre-assembled fifty-foot double plank transmission crossarms.

Equally important, you can save money with Graybar as your auxiliary warehouse for maintenance materials. For one thing, you can cover your needs on a single Graybar transaction. You can save also on handling the materials. And you can lighten your maintenance inventory, because Graybar carries the most complete stocks of *any* electrical distributor.

Start with a local call . . . Have your Graybar man come in. He is familiar with your problems. He knows his stock thoroughly.

When Graybar is your auxiliary warehouse —	You save on storeroom costs Reduce inventory investment Insure prompt delivery Step up manhour efficiency Simplify bookkeeping

948

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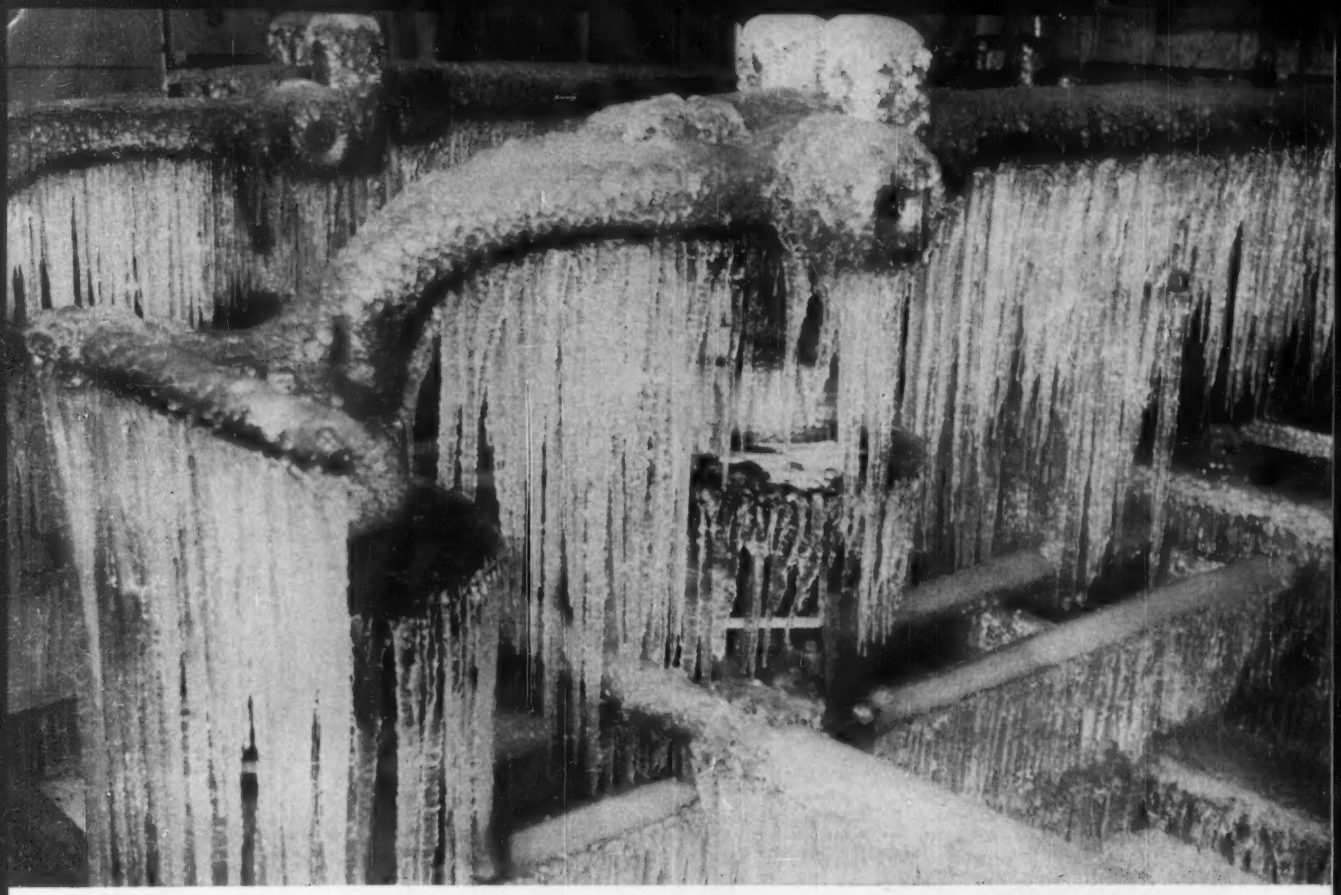


FREEZING RAIN CONDITIONS were maintained in large university's Climatometer until an ice coating averaging 3/4 inches was deposited on all horizontal surfaces of Type WAG 230 kv switch shown here in closed position. Similar tests were conducted on switches in open position.

WHEN ICE HITS... WHAT HAPPENS

When heavy icing occurs, will you still be able to open or close your air switches?

This is a question getting increasingly careful attention from engineers . . . both those who design such switches and those who apply them.

Horizontally mounted vertical break switches in the higher voltages present the greatest problem. The switch blade is long and a lot of ice can accumulate. For example a one-inch layer on the blades of a 230 kv, 3-pole switch of this type weighs approximately 132 pounds. Translate this into the extra effort required to open the switch and it comes to 2640 pound inches or 77 pounds on a 36″ swing handle. Adding further to the difficulties is the inherent design of the switch. Contacts are difficult to shield. When switch is closed, ice accumulates on the contact assembly. When open, the contact shoes become ice coated, making it necessary to chop the blade into the closed position under heavy impact.

Why do we point out such hazards to you?

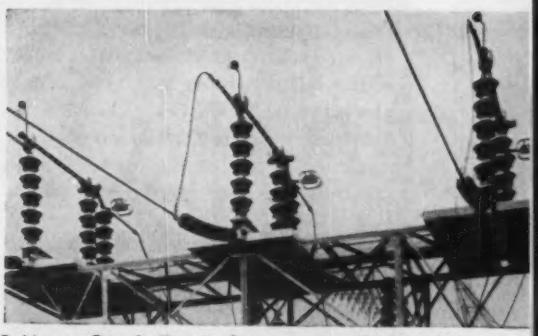
For one thing we know that our Type WAG can handle the problem. We have tested it under severe icing conditions, and it can be opened or closed by the efforts of one man.

3-POLE SWITCH IS OPENED by the efforts of one man. Heavy weight of Ice required extra effort, but switches were fully opened and were in operative condition after each test.

TO YOUR AIR BREAK SWITCHES?

The reason for the WAG's good performance under ice is simple: engineering and construction. The relationships of all moving parts are such that ice formations are in shear or tension. Force transmitting linkages are well-protected from ice accumulation. And all moving members are rugged enough to prevent deformation when the switch is forced open or chopped into the closed position.

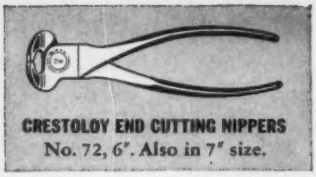
Southern States Type WAG will operate effectively under ice and other adverse operating conditions. For complete details, contact your Southern States representative or write us for Bulletin 59 WAG.



Baltimore Gas & Electric Company uses Southern States 230 kv, 1200 ampere WAG Switches as OCB disconnects on its Northwest substation, seen in the above photograph.

SOUTHERN STATES EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto



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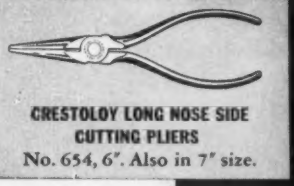

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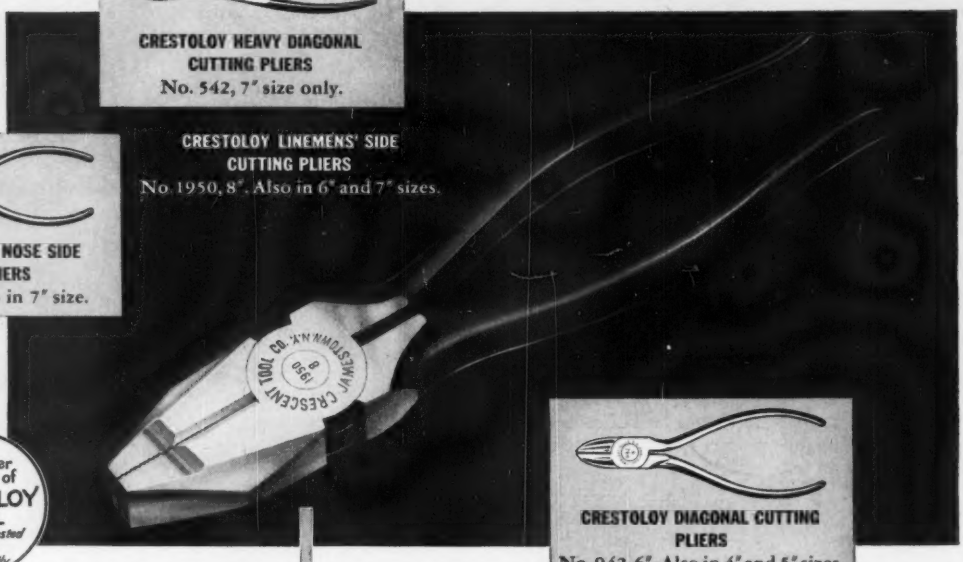

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When you choose a CRESTOLOY PLIER you know you are getting top value and proven performance. After rigorous factory testing for ease of cutting, hardness of blades and strength, each tool that passes these tests is tagged with the certifying tag reproduced above. CRESTOLOY PLIERS are available in more than a score of patterns including the five popular types illustrated.

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CRESCENT and CRESTOLOY TOOLS are sold by hardware dealers and industrial distributors everywhere. Look for the bright yellow Crescent Display panels and select from one of the world's greatest assortments of quality hand tools.

Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

WESTINGHOUSE POWERCASTING* predicts super-capacity plants... demanding automatic operation

Load growth is accelerating. To meet demands, utilities will continue to add generation capacity in ever larger units. Accompanying the super-capacity of equipment is its increasing complexity, far greater instrumentation, mounting need for reliability.

To control this massive, and expensive, facility efficiently or even adequately is fast approaching the limits of human ability. Emergency conditions bring the problem into critical focus. Operating variables throughout a typical station number in the hundreds. It is virtually impossible for personnel to assimilate all necessary data, to analyze and translate it quickly into the best course of action. Hurried decisions based on hasty scanning of complex interrelationships by operators under great stress make the possibility of major equipment damage a constant threat. Records indicate that chances are one in three a major accident will occur in the lifetime of your plant.

The cost of a single major outage due to operator error can easily exceed the total cost of a completely automatic control system. The automatic steam plant is coming because it must . . . to make your huge capital investment in generation operationally economical, reliable, safe for men and equipment.

*A Service-Mark of Westinghouse

Westinghouse

WESTINGHOUSE POWERCASTING*

Westinghouse program of product development concentrates on automatic power plant

Prodac† means PROgrammed Digital Automatic Control. It is a high-speed computer designed specifically for steam station system control. Here are just a few of the unique services Prodac can perform for you.

Special logic unit and priority director simplify and expedite the making of thousands of decisions required for sequencing and control of a generating unit. Sequencing changes are made automatically whenever needed to start up, shut down or run at maximum efficiency under either normal or emergency conditions.

Prodac rapidly and continually scans and logs all necessary system variables, keeps up-to-the-minute records. By extensive calculations, this information is presented in meaningful heat rates and unit efficiencies. After analysis, required changes are made automatically to optimize performance of the entire plant.

All sub-loop control systems for the turbine-generator, boiler, fuel, feedwater, and all other plant systems are completely coordinated and integrated in Prodac.

Plant reliability is greatly improved with special stored programs with which Prodac can at any time take high-speed corrective action, under both normal and emergency conditions. Operator error has been designed out.

Availability of each turbine unit is significantly increased by reducing start-up time, cutting down time. Maintenance is cut appreciably . . . plant equipment limits are not exceeded.

Manpower requirements are reduced because of the computer's ability to observe and interpret large

quantities of data, and to perform a multitude of control functions . . . unattended.

Because of Prodac's high speed, immense capacity and many exclusive functions, these and other rewards are available to you from Westinghouse.

Turbine and generator section

New sub-loop controls equip Westinghouse turbine-generators for automation.

These new devices and subcontrol loops are necessary to adapt the turbine-generator for control by digital computer.

A wide-speed range governor, utilizing a magnetic pickup and static control equipment, has been developed for use during turbine-generator start-up. It controls shaft speed to the value dictated by the computer start-up program.

The automatic turning gear automatically engages the gear and starts the motor when the rotor comes to rest. The "at rest" condition is detected by a hydraulic zero speed indicating device.

The lube oil, seal oil and hydrogen systems are equipped for complete automatic operation.

A capability curve regulator has been developed to assure that the generator always operates within the capability curve of the generator.

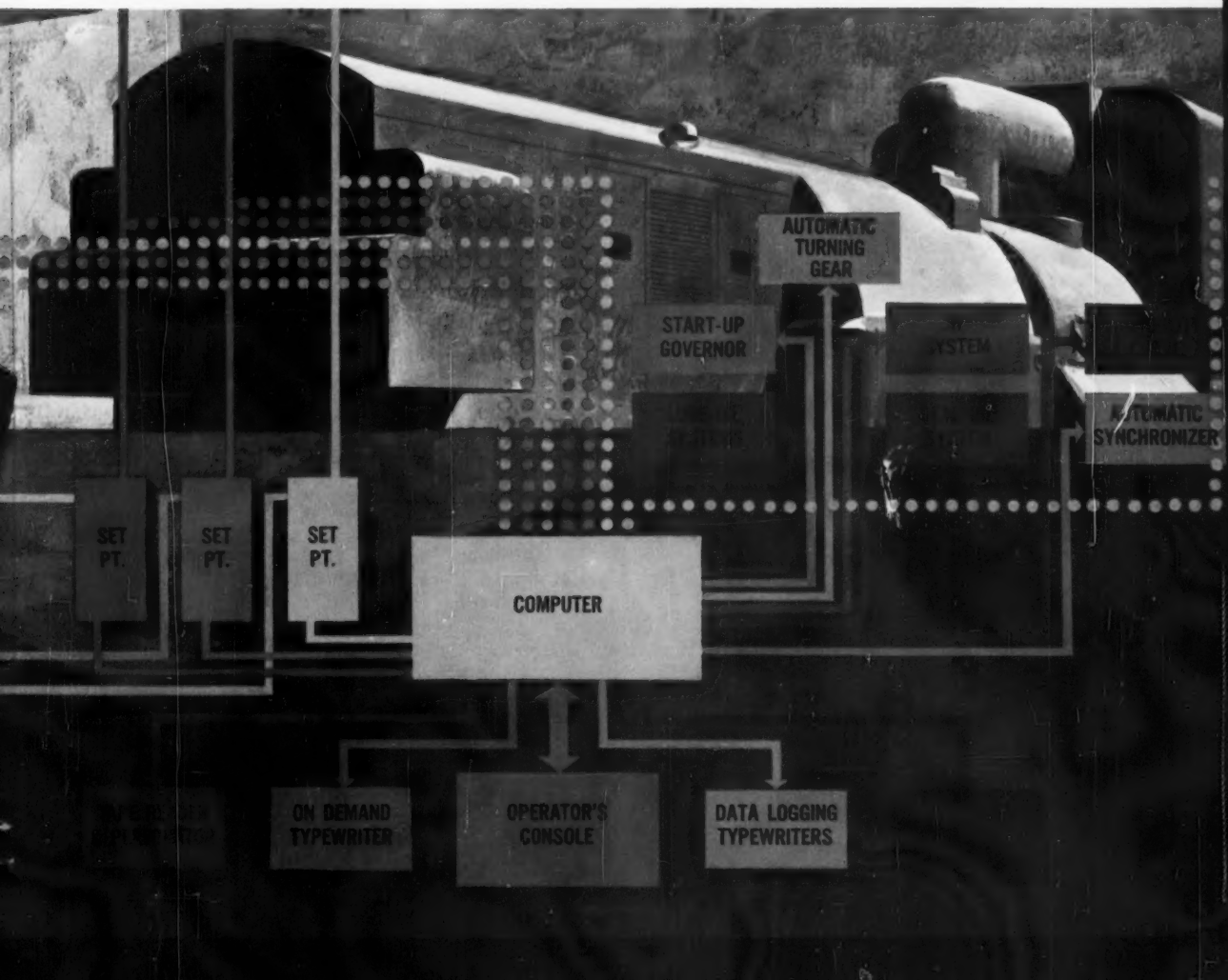
Westinghouse Powercasting can help you plan your system's future

Today, some utilities are faced with the immediate prospect of purchasing an automatic plant. You may be one of them. Whether or not you can make a decision now or any time may depend heavily upon the predictive and planning techniques available to you.

Westinghouse has developed a fundamentally new technique of total system planning . . . Powercasting. With the growing complexity of today's utility system, conventional planning methods just won't provide the answers fully or precisely enough. Therefore, Powercasting offers you a new way to create a plan, together with total capital investment needs, projected for the next 20 years.

*A Service-Mark of Westinghouse
†Trade-Mark

Westinghouse



Public Service with Westinghouse to automate its largest generating unit

Electric utility seeks today's ultimate in reliability—Westinghouse will engineer, furnish and coordinate the computer for automatic control on the Sewaren Generating Station Unit No. 5 for Public Service Electric and Gas Company of New Jersey. On-line target date—early 1962. On order—a 342,000-kw cross-compound turbine-generator and the new Prodac computer-control system.

This new unit will be more reliable than any conventionally controlled plant. Computer-control will provide greater reliability because it permits careful pre-programming of all normal and emergency operating procedures—precise, rapid supervision of incoming signals from hundreds of sensitive detectors—nearly instantaneous, multiple control of all critical power plant apparatus—anticipation and prediction of critical events before they occur, in time for corrective action.

The Westinghouse Prodac to be installed is the first industrial process computer-control using the unique new priority director to simplify the program, increase the operating speed and more efficiently utilize the memory capacity.

Westinghouse experience in the special problems and objectives of the electric utility industry is broad and deep. The men in Westinghouse, having this important experience capability, will use the most advanced analytical engineering and research facilities to help Public Service be certain that all aspects of this important project have been properly coordinated.

You can be sure . . . if it's Westinghouse.

Westinghouse

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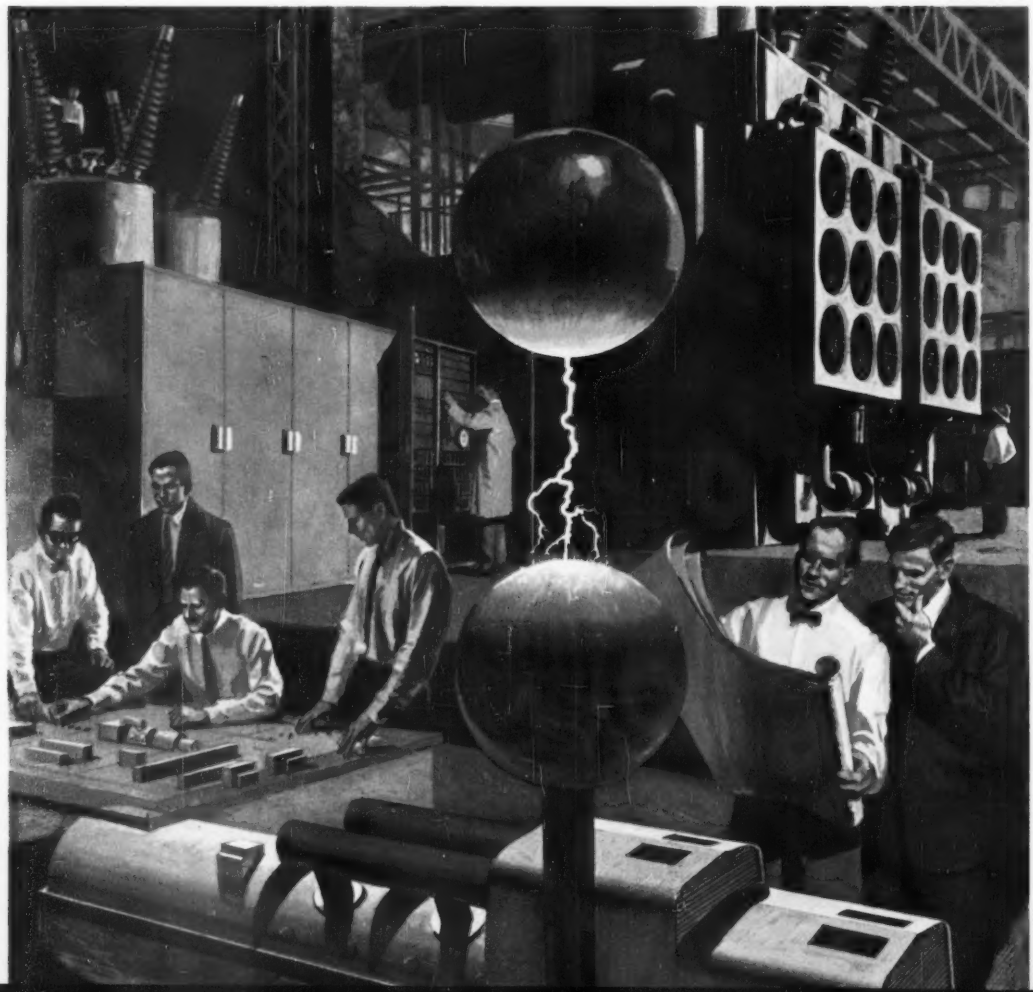

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NEXT WEEK

TELETYPE AND EDP speed gathering of data for accounting and management control.

LATE NEWS ▶ **Proposed merger of Southern Colorado Power and Central Electric** & Gas, Lincoln, Neb., is approved by directors of two companies. Central E&G serves about 7,700 customers in South Dakota and Minnesota; Southern Colorado, some 48,000 customers. Judson Large, president of Central E&G, is expected to head new firm, called Western Power & Gas Co. Southern Colorado stockholders will get one share in new company for each share now held. Southern Colorado earned $1.13 per share for year ending Sept. 30. After 12-for-10 stock split, Central E&G's earnings are $1.63 per share.

AEC asks co-ops and government-owned utilities to give "expressions of interest" on participation in 50-Mw organic-cooled and moderated nuclear plant. AEC would build the prototype unit, on which research and development has already started. Participants would be asked to furnish "as a minimum" the site and conventional facilities, and to operate the plant for at least five years. Replies are due Jan. 15, 1961.

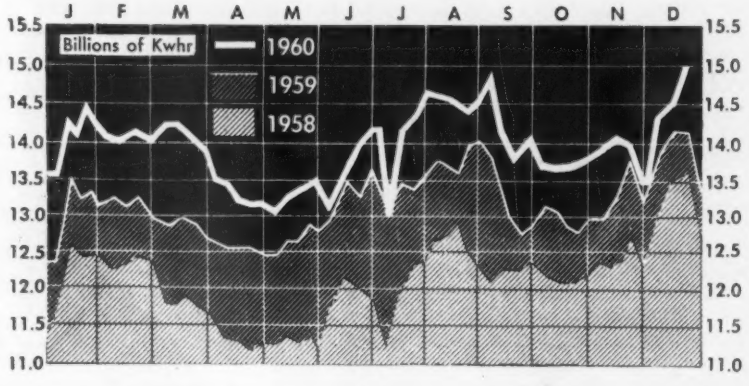
Accounting deficiencies by federal agencies prevent fair presentation of annual audit for federal Columbia River power system, according to US Comptroller General Joseph Campbell. Cited are failure of Bureau of Reclamation to record depreciation for power projects; failure by Bureau and Corps of Engineers to make firm construction cost allocations to power and non-power uses at Yakima, Detroit-Big Cliff, McNary, and The Dalles projects; and inconsistent accounting policies on interest on federal investment and depreciation of plant in service. Columbia system shows $10-million loss in commercial operations for fiscal 1960 compared to $6 million in fiscal 1959.

Weekly energy output for US passes 15 billion kwhr for 7-day period ending Dec. 17. . . . **US record for new meter installation** is claimed by Southern Cal Edison, reporting 714,000 in past decade and 72,000 in 1960. Utility also claims to have led all other US utilities in signing contracts for Medallion Homes in recent years. . . . **TVA sets new generation peak**—10,013 Mw—on Dec. 14. At the same time, system net load hit 9,939 Mw, a jump of 300 Mw over last March's previous peak and 24-hr generation hit 216.4-million kwhr.

All members of an electrical workers union in Santiago, Cuba, are reported thrown out of a government-operated power plant. Although no reason for the dismissal was given, it is known that union members have opposed efforts to impose communist leadership on the union. Anti-communist officials of the same union in Havana were purged recently, for "counter-revolutionary activities."

WEEKLY POWER OUTPUT—Up 6.2%

(Week ending Dec. 17), Kwhr 15,021,000,000



Per Cent Change From Previous Year

	Dec. 3	Dec. 10	Dec. 17
Total U. S.	+ 3.3	+ 3.1	+ 6.2
New Eng.	+ 4.6	+ 4.5	+ 7.2
Mid. Atlan.	+ 2.1	+ 0.6	+ 3.1
Cent. Indust.	− 1.0	− 1.9	+ 0.8
West Cent.	+ 3.9	+ 5.3	+ 8.3
Southeast	+ 3.4	+ 4.0	+11.2
South Cent.	+ 7.5	+ 8.0	+ 7.8
Rocky Mount.	+15.6	+19.5	+20.2
Pacific			
NW	+ 8.8	+ 5.2	+ 9.6
SW	+ 4.8	+ 6.2	+ 4.2

Seasonally Adjusted Index 276.3

Week Ago 273.6 Year Ago 260.4

Source: Edison Electric Institute

Supply Lines

MANUFACTURERS SET UP LIABILITY-SHARING PLAN

To cover damage settlements which may arise as a result of the antitrust suits, electrical equipment manufacturers are setting up a liability-sharing plan. It was not known early last week how many of the defendants would choose to join in the plan. However, the big three—Allis-Chalmers Manufacturing Co, Westinghouse Electric Corp, and General Electric Co—have already entered into a joint agreement and invited other firms involved in the Philadelphia cases to come in with them. Under the agreement, the electrical firms would allocate, according to sales by members involved in the Philadelphia cases, the cost of disposing of claims by customers. Under the Sherman Antitrust Law, customers may file claims and receive up to treble damages if it is found that they have suffered as a result of violations of the Law. One purpose of the manufacturers agreement is to avoid the possibility that one member of the industry will be required to pay a larger amount than it would if its sales alone were the basis of the claim against it.

While the existence of the agreement was not officially announced at the time *Electrical World* went to press, it follows closely on the heels of last week's announcement by GE, Allis-Chalmers and Westinghouse that they would initiate cooperative studies with all customers to determine if violations of antitrust laws had hurt customers financially (EW, Dec. 19, p 40). In that series of announcements, GE pointed out that the price of electricity has gone up only 2% since 1939 while the general Consumers Price Index went up 112%. R. S. Stevenson, president of Allis-Chalmers, said, "It is our belief that in most cases, if not all, no damage was done. In most instances our prices have not kept pace with the increases in labor and material costs particularly in the last few years. . . ." Mark W. Cresap Jr, president of Westinghouse, said, "We believe that all customers at all times have received full and fair values. . . ."

These cooperative studies would be made with a view to possible voluntary settlements on the part of the manufacturers. Those who have studied the possible effects of the cooperative studies and voluntary agreements suggest these possible advantages to utilities: (1) Voluntary settlements would eliminate the uncertainty of success of recovering claims through long-drawn-out court suits. (2) The voluntary program would offer the possibility of prompt settlement of claims and might ease pressures on utilities brought by customers, regulatory commissions, or shareholders. (3) The cooperative studies and voluntary settlement would bring together the knowledgeable men from both the manufacturers and the utilities—men who would understand the values and the products involved—to permit prompt and fair settlements. (4) This method would afford maximum flexibility in settling claims. (5) The initiation of cooperative studies and the offer of voluntary settlement, if the parties did not agree, would not preclude a court suit. (6) If court suits were instituted, manufacturers would be duty bound to vigorously resist claims. (7) The voluntary method would afford the least distraction to top personnel of both utilities and manufacturers and permit them to get along with more pressing industry business.

WASHINGTON PUD'S ASK RELAXATION OF BUYING RULES

Public Utility Districts in Washington will ask the state legislature for less restrictive laws governing purchasing procedures. PUDs will ask the lawmakers to:

- Permit purchases of materials and equipment up to $15,000 without calling for competitive bids. The limit is now $5,000.

- Shorten the 30-day bid period to 15 days.
- Allow the award of contracts 10% in excess of estimated costs of materials or work. Presently, awards are possible only when bids are below the estimate.
- Allow the rejection of all bids and permit the PUDs to do the work if the estimated cost is less than the lowest bid received, or if no bids are received.
- Remove the present limitation of $30,000 on the value of equipment which can be installed by PUD crews.

The districts acted at their annual association meeting earlier this month to bring these recommendations to the legislature. Purchasing procedures for public bodies vary from state to state and sometimes within a state. For instance, the Kefauver Committee hearings in Knoxville, Tenn., last year brought out that some power boards in Tennessee are not required to adhere to strict competitive bidding procedures, but may negotiate purchase contracts.

PROFIT SQUEEZE PLAGUES INDUSTRY, SAYS CRESAP

Intense cost-price pressure on profits will continue to be a challenge to most industry during the coming year said Mark W. Cresap Jr, president of Westinghouse Electric Corp, in a year-end statement. He noted that a decline in prices of electrical equipment as well as of appliances during the past year has put pressure on earnings. He estimated sales for this year would slightly exceed last year, and said the backlog of new orders was holding steady.

To ease the continuing profit squeeze, Cresap said, his company will increase research activity to accelerate the development and marketing of new products and increase capital expenditures to improve operating efficiency. Westinghouse plans call for its capital spending to rise from $60 million this year to $65 million next year.

Shipments of generating equipment will be up slightly in 1961 over 1960, Cresap predicted. He said that these shipments often indicate the volume of all types of capital equipment being delivered to customers.

MANUFACTURERS TO CONTINUE TO FACE TOUGH COMPETITION

Continued pressure on prices and tough competition are predicted for electrical equipment manufacturers by *The Value Line Investment Survey* in its December industry analysis.

"Prices are a problem," says the survey. "They have been under pressure in virtually all segments of the industry. Excess capacity is seeking orders. Meanwhile, competition from foreign goods increases. Profit margins have crumbled. This explains the determined stand taken by General Electric Co and Westinghouse Electric Corp in the recent wage negotiations which resulted in a modest settlement."

Competition in the electrical equipment industry, says *Value Line,* is now tougher than at any time in the past decade and will probably intensify. The investment survey says physical output of this industry is expected to outpace the Federal Reserve Bank index by a wide margin, but "we no longer look for a product price level any higher than the current."

Herman O. Stoelting, Development Engineer and well known authority on lightning protection, exhibits L-M's line of distribution lightning arresters. L-M offers the most complete line. Type E distribution arresters from 1 through 20 kv; Type SS high voltage distribution arresters in 27 and 30 kv; open gap Type TX arresters from 3 to 18 kv. The line includes some ratings not generally offered, such as 20, 27, and 30 kv.

L-M Offers Most Complete Line Of Distribution Lightning Arresters

Line Material, long a leader in lightning arrester development, recognizes the importance of proper arrester application. Arresters rated lower than the actual voltage requirements can be a frequent cause of trouble. Failure to consider system overvoltages and unbalance can result in arrester failure.

Line Material therefore offers a complete line, that permits the distribution engineer to make more accurate selection of the proper arrester to meet the requirements of the specific system, voltage, and location.

Get Details on Arrester Ratings, Features, Application

Ask the L-M Field Engineer for information on L-M Arresters and application data; or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: CLM Industries, McGraw-Edison (Canada) Limited, Toronto 13.

FOUR OUTSTANDING BENEFITS FROM USING L-M ARRESTERS

1. Long life; durability equalling station arrester standards, because of the characteristic element, plus lens electrodes in the element, and superlative moisture sealing.

2. Excellent protection of associated equipment; low impulse sparkover; high discharge capacity; generous margin of protection for transformer BIL. This has been proved by 20 years of field experience with some 2½ million L-M arresters now in service.

3. Prevention of line lockout by the L-M-originated Isolator (or external gap on Type TX). The Isolator was an L-M "first"—a vital contribution to the industry. The L-M Isolator has definite dependable time-current characteristics to permit accurate coordination.

4. Fewer operations of, and less wear on, sectionalizing equipment. With high follow currents, reclosers operate more frequently. L-M valve arresters have very low follow current due to the design, and back-up reclosers are called on to operate much less frequently.

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McGRAW-EDISON COMPANY

Lightning Arresters

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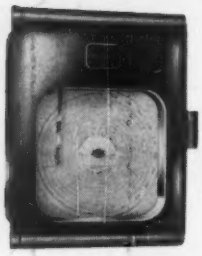
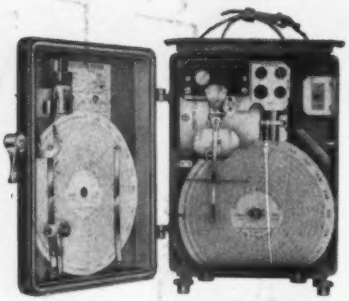
DISTRIBUTION TRANSFORMERS • RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT



Bristol Recording Voltmeter for permanent mounting.



Bristol Recording Voltmeter for portable use. Compact Series 631.

Bristol's rugged, moving-iron element:

Key to RECORDING VOLTMETER ACCURACY and RELIABILITY

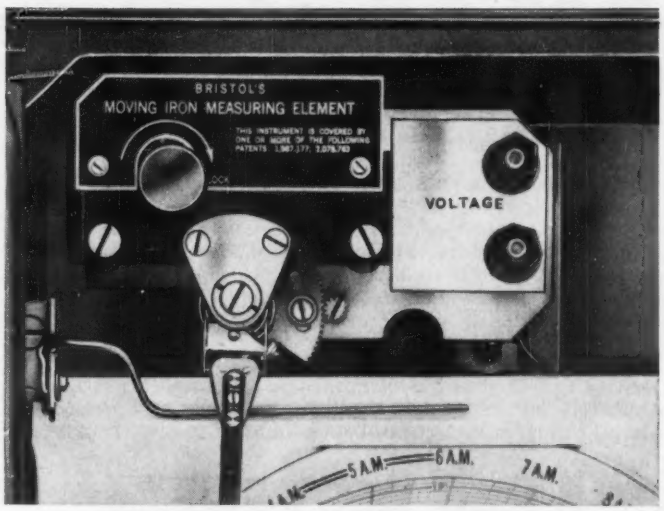
Up to 3 elements, 3 pens, per instrument for recording up to 3 independent voltages on a single chart

Nobody can make a recording voltmeter movement like Bristol... field-proved for year-in and year-out dependability and precision. Check these outstanding features:

- **Thermistor compensated.** Results in negligible temperature error.
- **High Accuracy.** ±1% of full scale.
- **High-Torque.** The Bristol moving iron mechanism produces greatest feasible torque, keeps weight and power drain to a minimum, assures positive recording over full range.
- **Low Electrical Burden.** Only 5.5 VA at 120V for each mechanism.
- **High Calibration Stability.** Seldom requires calibration.
- **Easy Calibration in Field.** No special tools or skills required.
- **Rugged Construction.** Shockproof ball-bearing movements; pen locking device for shipping or carrying portable models.
- **Leveling Not Critical.**
- **ASA Models Available.** Meet Specification C39.2-1953.

These are just a few of the good reasons it will pay you to standardize on Bristol 1, 2, or 3 pen recording voltmeters. For more facts on Bristol recording voltmeters and ammeters, write for Bulletin E1111.
The Bristol Company, 116 Bristol Road, Waterbury 20, Conn.

O.3



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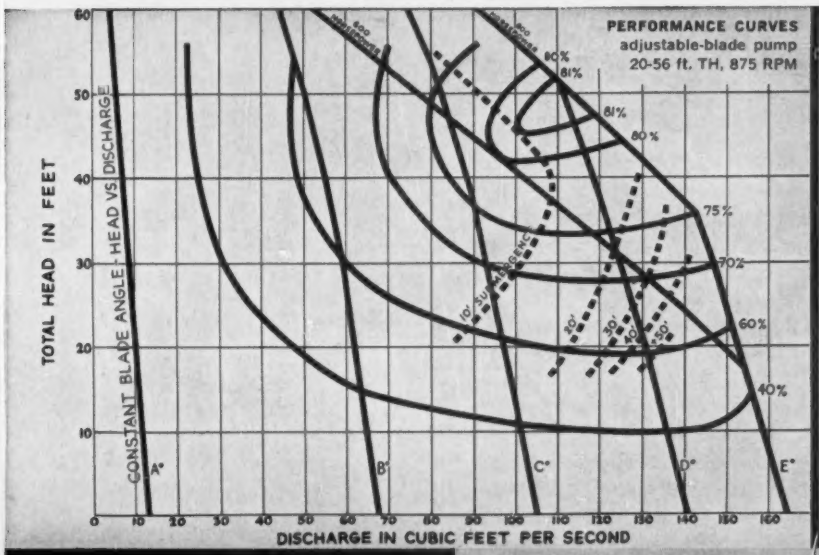
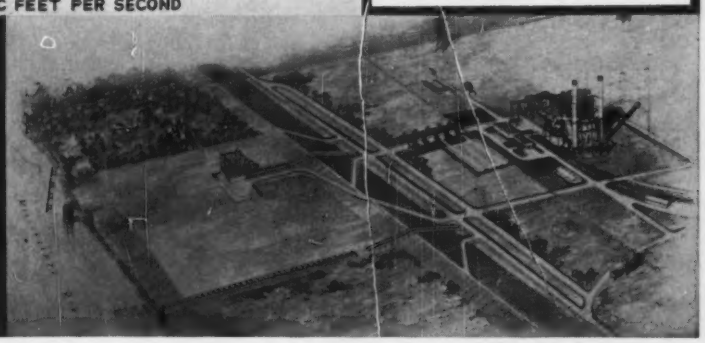
ALLIS-CHALMERS

A-1393



Performance curves of the A-C adjustable-blade axial flow pumps for Willow Glen illustrate their extreme flexibility. Pump operation is not restricted to a single head-discharge curve as is the case with fixed-blade pumps, but provides any discharge and head combination within the limits of motor horsepower and proper submergence.



Stone & Webster Engineering Corp. is designing and constructing the Willow Glen Plant at St. Gabriel, La. on the Mississippi River for Gulf States Utilities Co.

Flexibility and efficiency make Allis-Chalmers adjustable-blade pumps choice for Willow Glen

Two 30-inch Allis-Chalmers adjustable-blade axial flow pumps provide condenser water for Unit #1 at the new Willow Glen Power Station. To meet requirements at minimum river level, with water temperatures that vary between 39°F and 90°F, the pumps were designed to deliver a total of 76,000 gpm against a 54-foot total head.

Extreme variation of suction pool elevation and the flexible condenser operation required for this station made adjustable-blade pumps the logical and economical choice. A-C adjustable-blade pumps attain relatively high efficiencies over a wide discharge and head range. This is accomplished by varying the pitch of the impeller blades while the pump is operating at constant speed. This adjustability keeps pumping costs at a minimum by combining low starting torque with high average efficiency.

Pump Bulletin 165 will give you complete information on high capacity axial flow pumps. To get your copy, write to **Allis-Chalmers,** *Hydraulic Division, York, Pennsylvania.*

Calgary Power installs first USS "T-1" Steel penstock in America

Near Chinaman's Peak in the Canadian Rockies, Calgary Power, Ltd., has completed the first penstock in this hemisphere built with USS "T-1" Steel. The 1,601-foot-long, 8′ diameter penstock is part of their "Spray No. 2 Project" to produce more hydroelectric power for the Calgary Power System in Alberta, Canada.

Montreal Engineering Co., Ltd., who recognized the value of USS "T-1" Steel as an excellent constructional alloy steel for such applications as high head penstocks several years ago, proposed its use when the design work for Calgary's "Spray No. 2 Project" was started.

Montreal Engineering Company's engineers specified USS "T-1" Steel for this penstock because the steel's minimum yield strength of 100,000 psi made possible nearly a 50% savings in the amount of steel required. This saving helped to reduce substantially the transportation and erection costs that would have been required had structural carbon steel been used in this mountainous location.

In the new Calgary penstock, 500 tons of USS "T-1" Steel plate 5/16″ to 3/4″ thick were used by Dominion Bridge to fabricate the segments, or "cans" in its Calgary plant. These segments are 8′ to 7′ in diameter.

It was significant that the penstock was designed to a 37,000 psi unit working stress (or approximately 41,000 psi unit stress at 90% joint efficiency). This is more than 28% greater than the ASME code case 1204-4 allows for pressure vessels fabricated of "T-1" Steel in the United States.

The upper exposed length of the USS "T-1" Steel penstock will come down the mountain at various slope angles with a maximum of 50 degrees for 1,400 feet above the tunnel and approximately 50 degrees in the 220-foot-long tunnel at the bottom. The water will have a head of 905 feet and will drive a turbine to produce 50,000 KW of electric power.

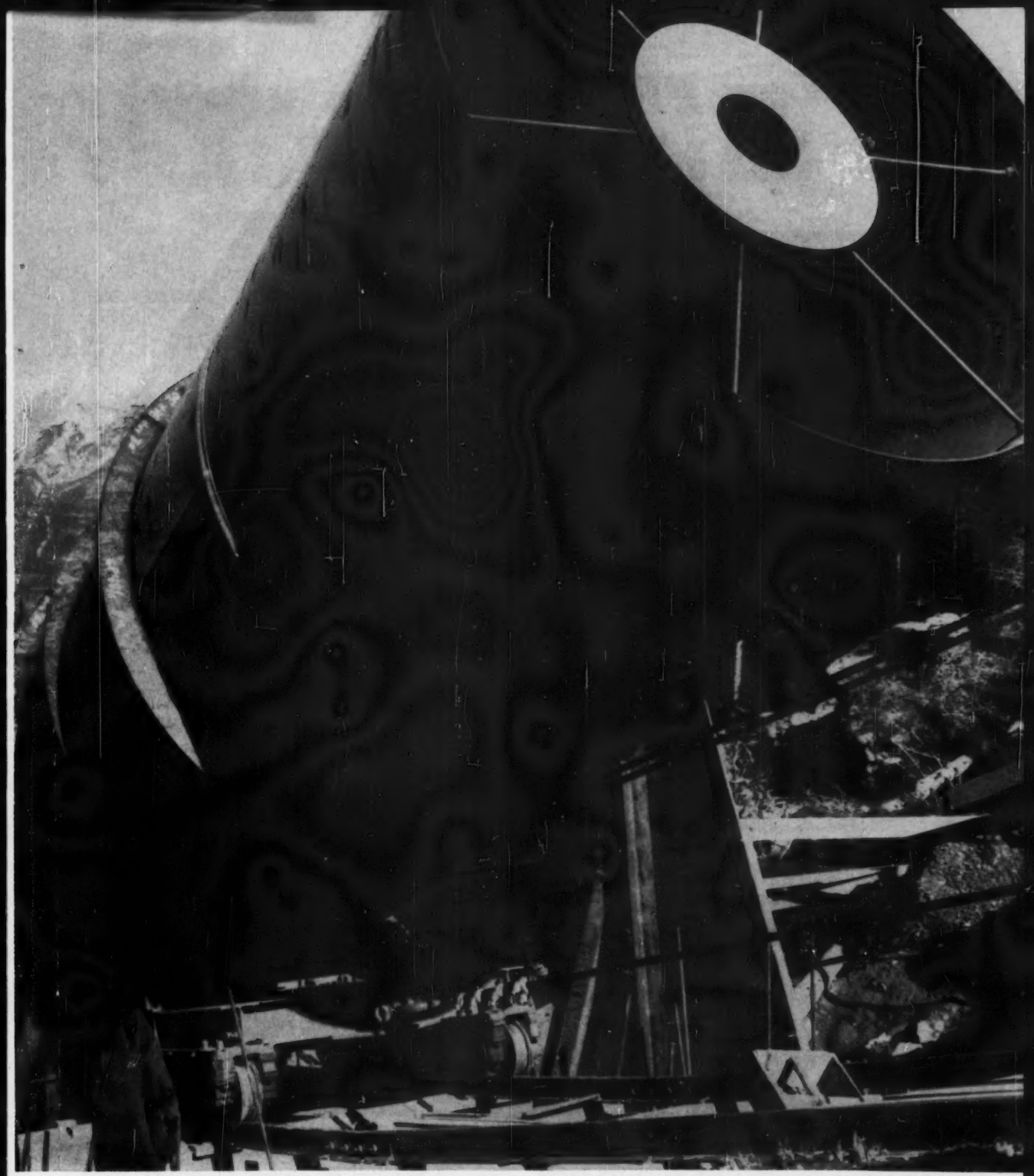
USS "T-1" Steel was selected for its exceptional strength and toughness, even at very low temperatures, and its ready weldability. What's more, it eliminates the cost of stress relieving.

For more information about USS "T-1" Steel, write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and "T-1" are registered trademarks

Whiteman's Pond, start of the penstock for the Calgary Power Spray Project.

This mark tells you a product is made of modern, dependable Steel.



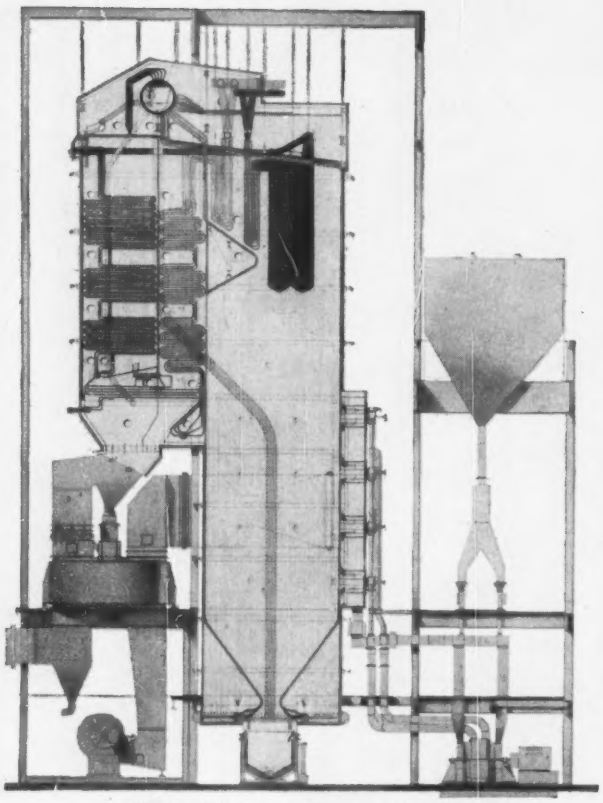
Above-ground penstock section of USS "T-1" Steel winds downward from Whiteman's Pond through the wild grandeur of the Canadian Rockies.

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
National Tube—Pittsburgh
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

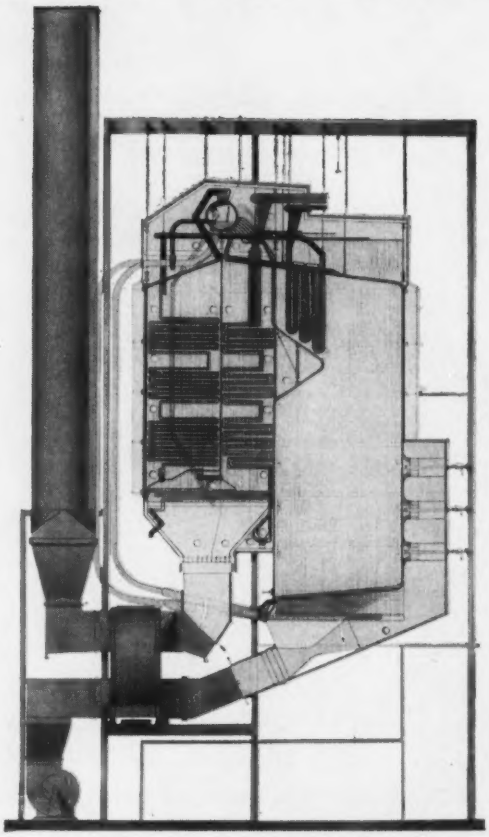
United States Steel

USS

Are You Planning To Burn COAL? OIL or GAS?



950,000 lbs./hr., 1950 psig, 1000/1000F;
Fired By Riley Pulverizers, Flare Type Burners



1,020,000 lbs./hr., 1925 psig, 1005/1005F;
Fired By Gas, Oil — Pressurized Furnace

Riley Custom Boiler Engineering, Know-How In Combustion Can Give You Top Performance Regardless Of The

Riley Boilers Equipped With Complete Riley Fuel Burning Systems

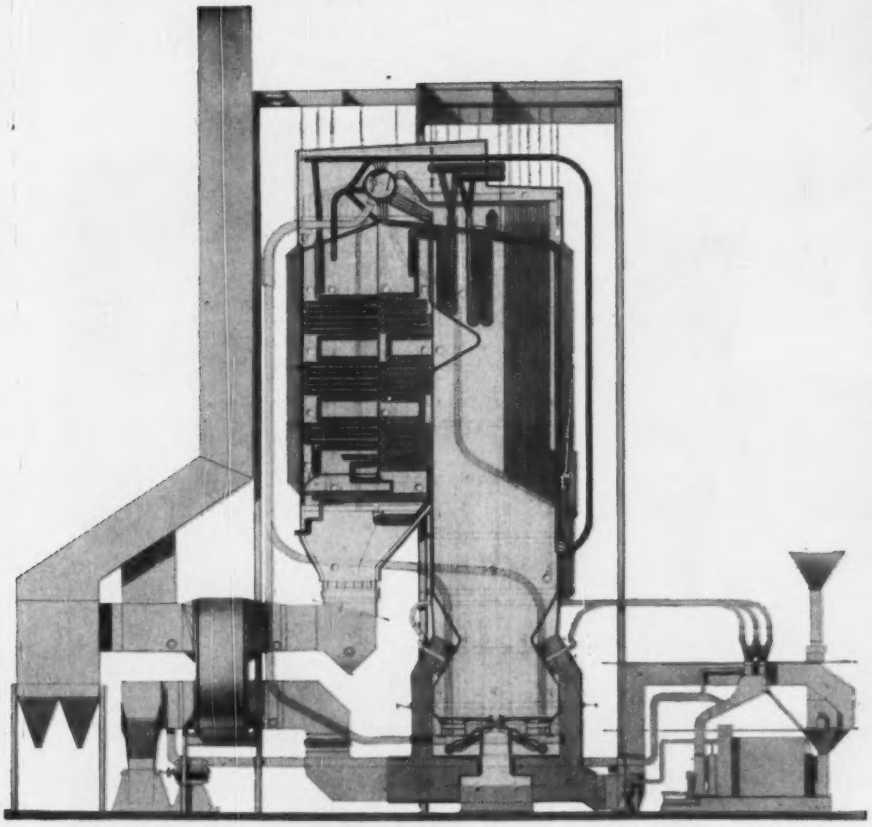
For pulverizing coal Riley offers two types of mills: the Riley Pulverizer and the Riley Ball Mill. These are used with either horizontal Riley Flare Type Gas/Oil/ Coal Burners, or with Riley multiple fuel Directional Flame Burners in Turbo Furnaces. A Riley Boiler installation complete with Riley fuel burning equipment assures Riley's undivided responsibility.

Turbo Furnace Boilers Designed Especially For Multiple Fuels

The Riley Turbo Furnace is ideally suited to firing multiple fuels. When firing coal furnace remains slag-free, flyash disposal is eliminated, carbon loss is negligible. Flame characteristics of gas, oil and coal are similar, simplifying steam temperature control. Available with reheat, non-reheat, with pressurized and non-pressurized furnaces in all capacities and pressures.

A Survey Of Your Plant by A Qualified Consulting Engineer Can Show You Ways To Make

or ALL THREE ?



1,600,000 lbs./hr., 2125 psig, 1005/1005F; Turbo Furnace with Riley Ball Mills; Pressurized Furnace. Fuels — Gas, Oil, Coal

SOME PUBLIC UTILITIES USING RILEY EQUIPMENT

Louisiana Power & Light Co. (3)
Texas Electric Service Co. (3)
Houston Lighting & Power Co. (13)
Dallas Power & Light Co. (3)
Kansas Gas & Electric Co.
Public Service Co. of Indiana, Inc. (12)
New Orleans Public Service, Inc. (3)
The Holyoke Water Power Co.
Columbus & Southern Ohio Elec. Co.
Central Illinois Light Co. (8)
Hartford Electric Light Co.
Central Power & Light Co.
Monongahela Power Company
Arkansas Power & Light Co.
Southwestern Gas & Electric Co.
Utah Power & Light Co. (3)
Florida Power Corporation (2)
Delaware Power & Light Co.
Minnesota Power & Light Co. (2)
Pacific Gas & Electric Co.
Iowa Public Service Co.
Commonwealth Edison Co.
Manila Electric Co.
Southern Nevada Power Co.
Interstate Power Co. (7)
Northern States Power Co.
Central Louisiana Elec. Co. (2)
Union Electric Co. of Ill. (2)
Northern Virginia Power Co.
Union Electric Co. of Mo. (7)
Pennsylvania Electric Co.
Iowa Electric Light & Power Co. (3)
Iowa-Illinois Gas & Electric Co. (7)
Montana-Dakota Utilities Co.
Mississippi Power Company
Philadelphia Electric Co. (4)
Central Ohio Light & Power Co. (6)
Gulf Power Co. (4)
Otter Tail Power Co. (5)
Public Service Elec. & Gas (N.J.) (7)
So. Carolina Elec. & Gas Co. (3)
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Techniques, Selectivity Of Fuel Burning Equipment Nature of Fuel, Load, and Steam Conditions

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Riley Service Engineers are trained for prompt and efficient servicing of all Riley installations. These experienced engineers work closely with your operators.

Riley Stoker Corporation, having successfully met the challenge imposed by the remarkable growth of the public utilities in the past decade is thoroughly prepared to meet the even greater challenges to come.

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HOLOPHANE Prismatic Control Assures Effective, Economical Lighting for Commerce and Industry

Holophane quality products provide the answer for those who seek high lighting levels... visual comfort... economies in maintenance... Holophane's recognized leadership in commercial and industrial illumination is backed by long experience, concentrated knowledge and the constant development of new and better lighting equipment.

A: NO. 6000: DECOLITE* ... One-piece, 4-foot-long, ceiling-attached luminaire with TWIN-CONTROLENS* ... PRISMALUME* (acrylic plastic)

B: NO. 6500: REALITE* ... PRISMALUME*, CONTROLENS*

C: NOS. 480-481 ... Wall-mounted Luminaire for wide-spread outdoor lighting; incandescent or mercury vapor lamps.

D: NO. 635 LOBAY* Reflector for 400 W.-mercury vapor lamps.

E: NO. 04343 POSTOP* ... One of series; fan-shaped light distribution; slip-fit for 3" pole.

F: NO. 440 WIDE-SPRED* Outdoor Refractor with cast-aluminum bracket (No. 0877).

Holophane
Trade Mark

Write for Engineering Data

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THE HOLOPHANE CO., LTD., 418 KIPLING AVE. SO., TORONTO 18, ONT.

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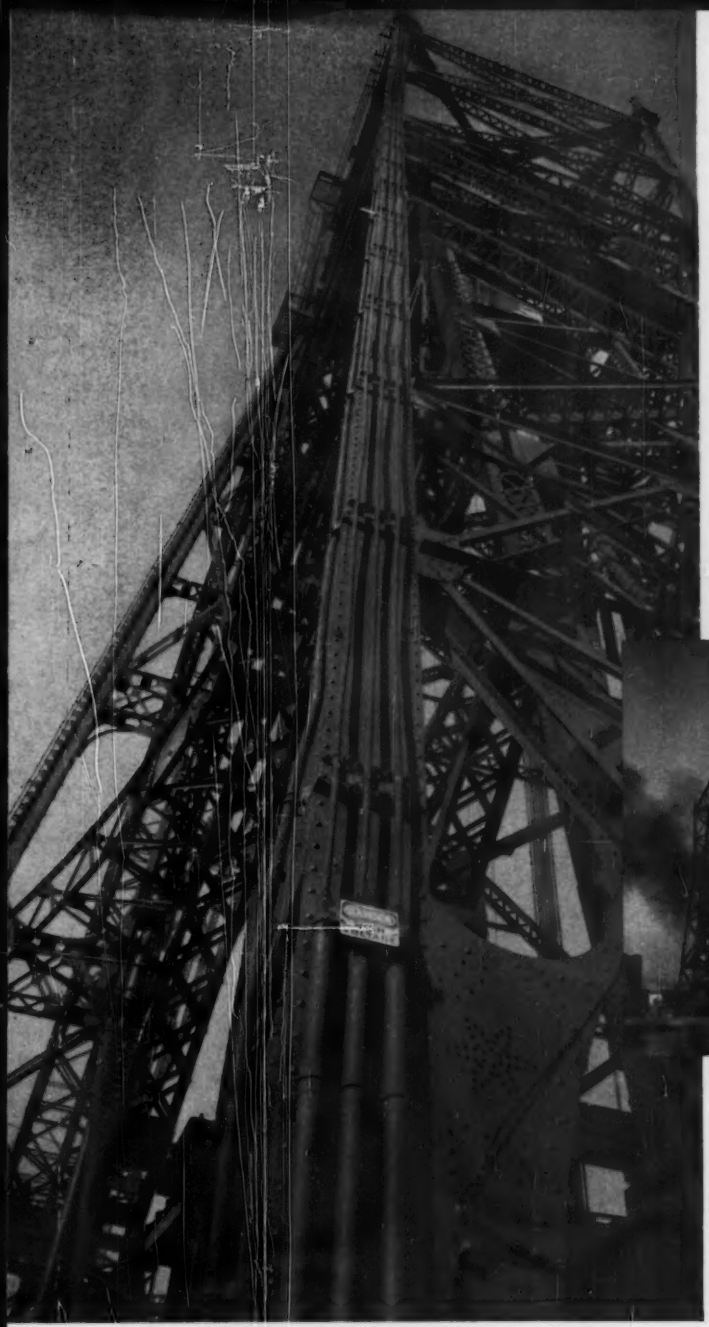

Vibration... Intense Cold...

POLYETHYLENE-INSULATED CABLES DEFY RIGOROUS BRIDGE CONDITIONS!

Early in 1955, at temperatures well below zero, three 14-kv power cables insulated with BAKELITE polyethylene and jacketed with Densheath PVC were installed on this aerial lift bridge at Duluth, Minn. Five winters later, the cables are still giving dependable service, despite the hazardous conditions of bridge vibration and extreme cold. Cables were manufactured by the Anaconda Wire and Cable Company for the Minnesota Light and Power Company.

Bridge installations provide one of the most rigorous physical tests for power cables. Only the toughest insulation can withstand for extended periods the damaging effects of bridge vibration . . . especially at low temperatures!

Three high-voltage cables insulated with BAKELITE polyethylene have passed such a test and, after five years, are still giving unfailing service. The polyethylene insulation has resisted not only the expected mechanical abuse, but the frigid Minnesota winters as well. Average winter temperatures in this area are 10 to 15 deg. F. and temperatures may reach as low as –41 deg. F.

Insulation of BAKELITE polyethylene has proved to be tough, durable, highly resistant to moisture and cracking, and an excellent low-loss dielectric . . . even at low temperatures. Union Carbide Plastics Company has pioneered the development of polyethylene and vinyl insulating and jacketing materials for optimum performance under severe conditions. For specific information on BAKELITE polyethylene and vinyl compounds, please write to Dept. HN-43. Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York. *In Canada:* Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE

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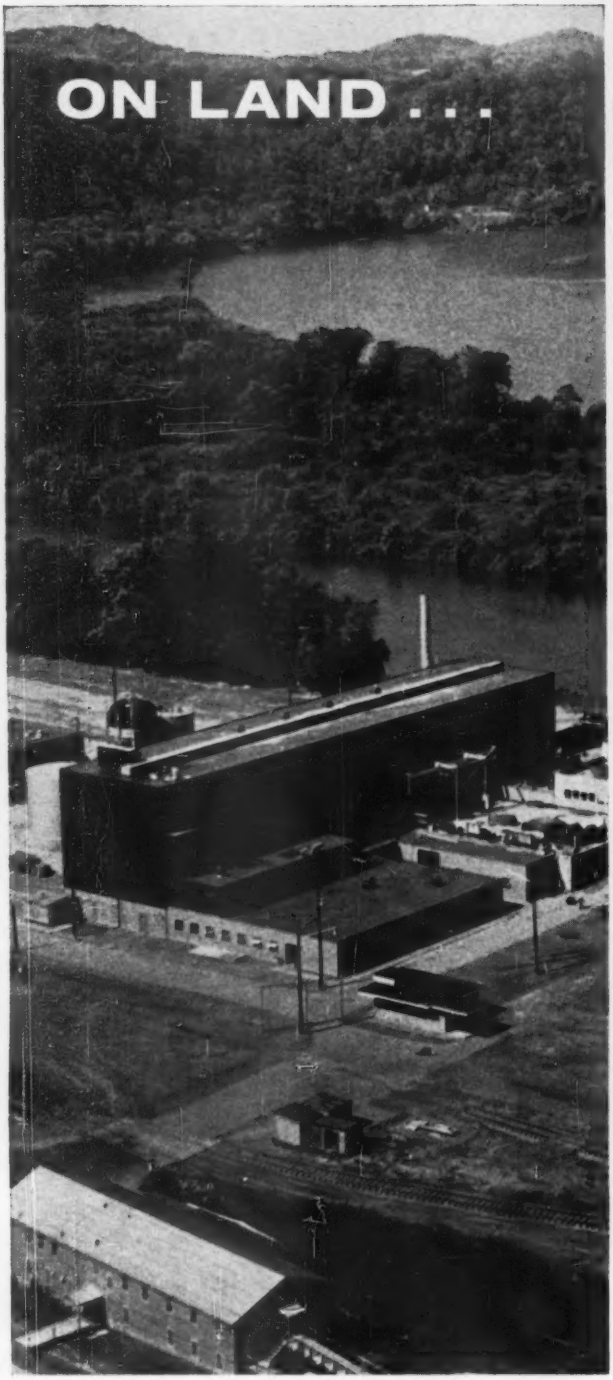
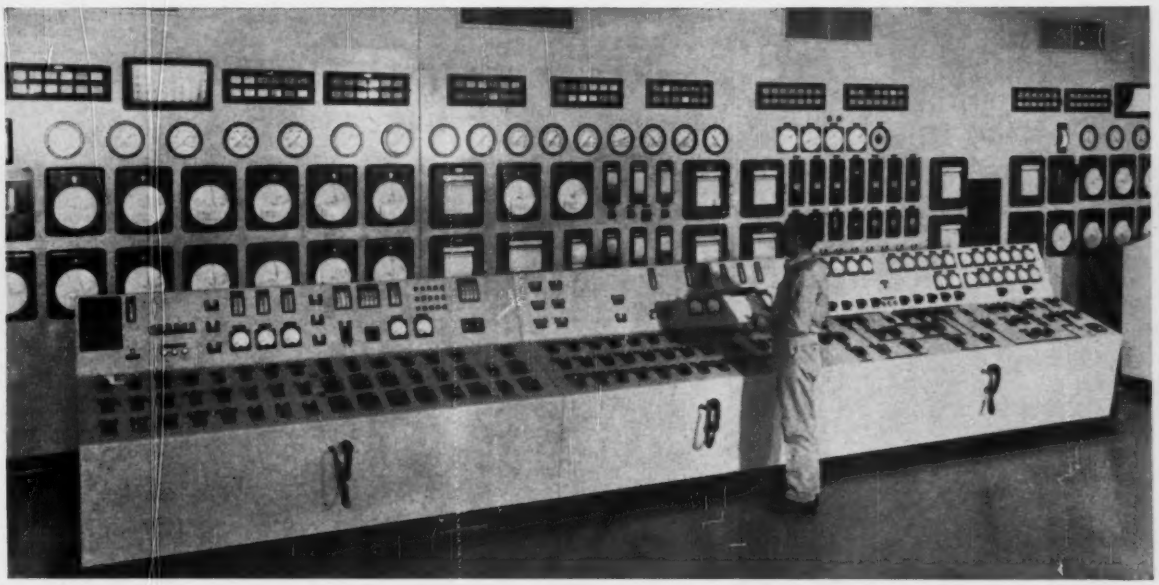


At the Shippingport Station, world's first full-scale atomic, electric power plant devoted exclusively to civilian use, Bailey instruments and controls help to secure full capacity and safety.

Typical of the modern U.S.-Flag tanker fleet using Bailey controls is the ESSO Gettysburg. You'll also find Bailey controls aboard Naval ships, cargo ships and lake steamers.

Bailey meters and controls in centralized control room at Tulsa Power Station, Public Service Company of Oklahoma. In steam-electric generating plants of this kind, Bailey has installed more combustion, feed water and steam temperature controls than have all other makers combined.

IT'S BAILEY...



for the latest and safest instruments and controls for nuclear and conventional power plants!

Many of the power plants of the future will have controls and instruments designed and built by Bailey. There are two reasons: Bailey's continuing research and development toward the latest equipment for industry's needs; Bailey's 40-year association with the hardware and economic requirements of the industry.

If you are planning new or improved power plant facilities, call on Bailey engineers to insure that your system will have the *proper balance both as to economics and needs . . . that there will not be the unnecessary expense of over-instrumentation or control . . . nor the duplication of equipment functions.*

Call on Bailey for primary sensing devices, indicators, loggers, control units, panels, data handling equipment, computers for performance analysis, and supervisory controls. You'll find designs ranging from conventional to the most sophisticated . . . mechanical, pneumatic, electric and electronic, including solid state.

There's a Bailey District Office or Resident Engineer close to you. Check your phone book, or write direct.

A142-2

Instruments and controls for power and process

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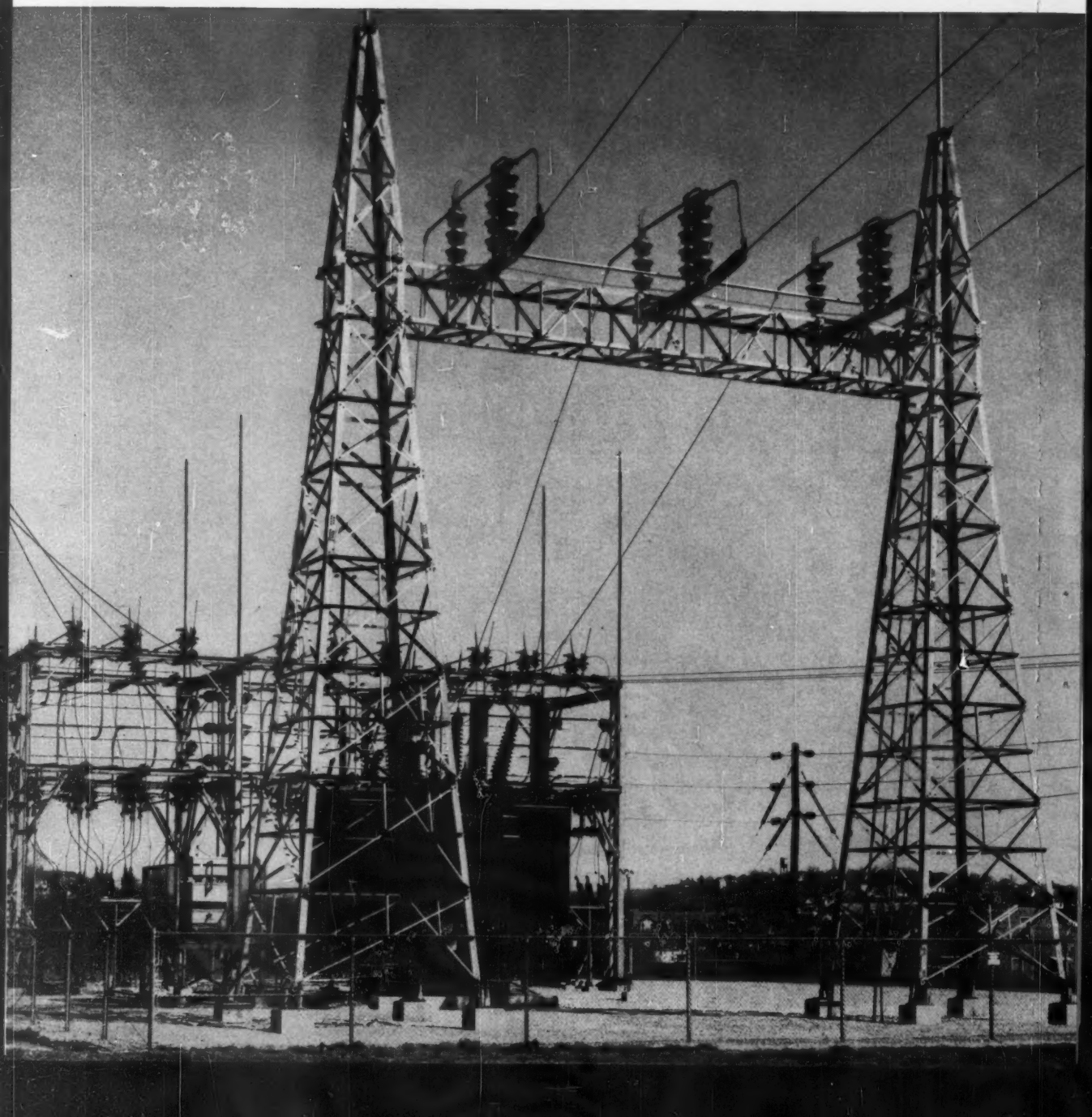
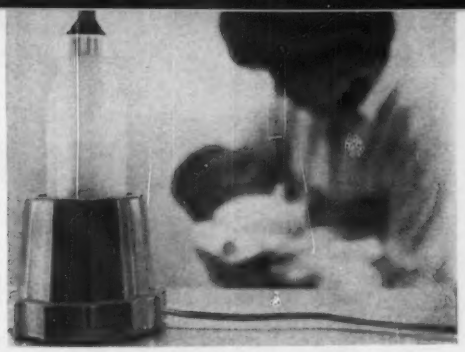
In Canada—Bailey Meter Company Limited, Montreal

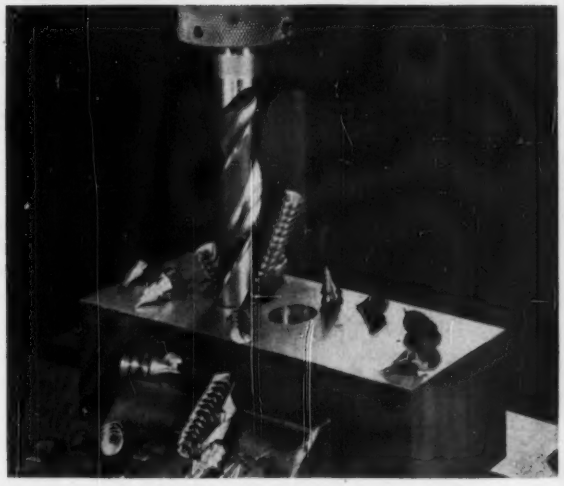
STEEL SUBSTATIONS

help West Penn Power serve





new industries–new customers



West Penn Power's Huntingdon Substation built economically with USS Galvanized Structural Steel—the material that offers low first cost, strength and reliability.

West Penn Power serves a large area in Western Pennsylvania and has a capacity of over 1¼ million kilowatts. More than half of this was added in the past ten years. Intelligent promotion of the area attracted new industries, new homes, shopping centers and other businesses.

To supply a rapidly growing area about 20 miles east of Pittsburgh, West Penn built the new 30,000 kva Huntingdon Substation. This is fed by a 132 kv line and distributes power by four 25 kv lines.

Steel selected for strength and durability. There are 55,369 pounds of Galvanized USS Structural Steel in the Huntingdon substation, and most of West Penn's other substations are built of steel. There has never been any structural damage in these substations according to Mr. A. W. Scheib, District Engineer. The stations are designed for ice loads, high winds and stresses caused by short circuits.

Steel keeps costs low. The installed cost of galvanized structural steel is often considerably less than other materials. Since galvanized steel structures can go without painting for many years under normal atmospheric conditions, they offer long-term economy as well as lower first cost.

When you design in steel, you are using a proven material that will give years of satisfactory service. For more information, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS is a registered trademark

USS

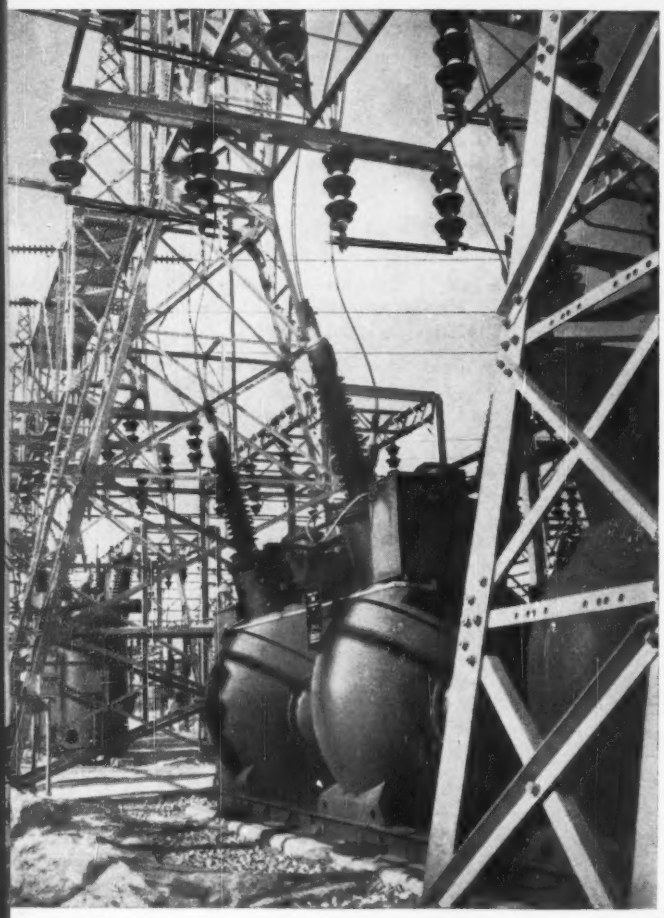
United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel

This mark tells you a product is made of modern, dependable Steel.

Four steels that will help you design

A7 and A36 Structural Carbon Steels . . . USS MAN-TEN and USS transmission towers involves choosing the materials that will do the best efficient material you can use because you can design to meet specific three degrees of atmospheric corrosion resistance. All have good fatigue to reduce weight, add strength, or increase durability. Here are the advan



ASTM A7
Structural Carbon Steel

In the galvanized form this steel has been used more often than any other material. When galvanized it has excellent corrosion resistance and gives long service life under nearly all conditions. Its minimum yield point is 33,000 psi.

ASTM A36
Structural Carbon Steel

This is a new, stronger carbon steel with a minimum yield point of 36,000 psi—9.1% higher than ASTM A7 structural steel. It will allow an increased design stress of almost 10% with significant cost savings in fabricated and erected structures. This steel is also used in the galvanized condition.

USS MAN-TEN
High Strength Steel

50% stronger than A7 structural carbon steel, USS MAN-TEN is the lowest in cost of the high strength steels. In the uncoated condition it has atmospheric corrosion resistance about double that of carbon steel. It permits weight reductions up to 33%, and results in lower costs when weight savings are as low as 17%. Galvanized MAN-TEN Steel is recommended for large substations and towers where extra strength without additional weight is needed. Minimum yield point is 50,000 psi.

more efficient substations at lower cost

COR-TEN High Strength Steels An efficient design for substations or job at the lowest annual cost. Steel, with its different grades, is the most requirements. These four steels offer three different strength levels and strength and the high strength steels can be used in the larger structures tages of each type of steel.

USS COR-TEN
High-Strength Low-Alloy Steel

This is the original high-strength low-alloy steel that offers atmospheric corrosion resistance of four to six times that of structural carbon steel. COR-TEN Steel's corrosion resistance is so superior that it may be used bare without coating or painting. That's because COR-TEN Steel develops an oxide coating which adheres with extreme tightness and does not flake off. Moisture cannot penetrate this smooth, dense oxide so that further corrosion is greatly impeded.

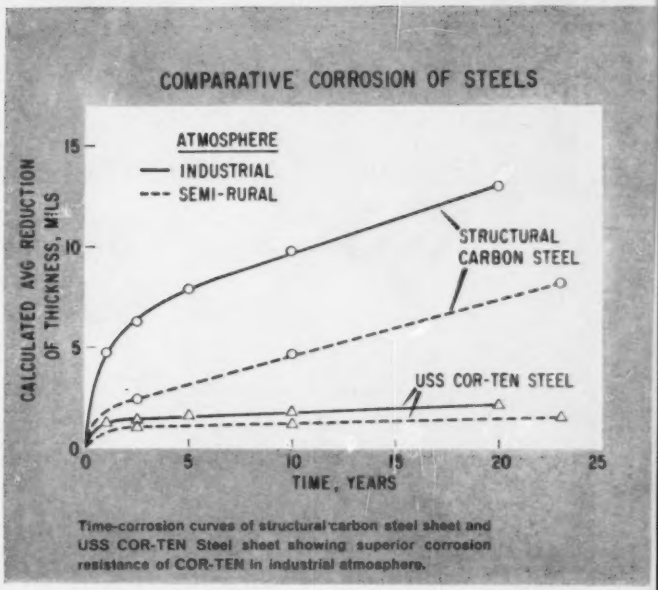
Exposure tests on bare COR-TEN Steel, conducted continuously since 1935, show that it loses very little weight after the first two years. Thin COR-TEN Steel sheets, .0298" thick, exposed to corrosive atmosphere for 25 years are still almost as good as new.

Bare COR-TEN Steel transmission tower structural members installed 12 years ago in Chicago's industrial atmosphere have shown no measurable loss of thickness.

The fact that COR-TEN Steel can be used bare will save untold thousands of maintenance dollars for any utility where atmospheric corrosion poses a maintenance problem. Its high minimum yield point of 50,000 psi permits large structures to be built lighter in weight without sacrifice of strength or durability.

USS, COR-TEN and MAN-TEN are registered trademarks

For complete technical information on any of this family of cost-reducing steels for electrical construction, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.



Time-corrosion curves of structural carbon steel sheet and USS COR-TEN Steel sheet showing superior corrosion resistance of COR-TEN in industrial atmosphere.

United States Steel Corporation—Pittsburgh
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United States Steel Supply—Steel Service Centers
United States Steel Export Company

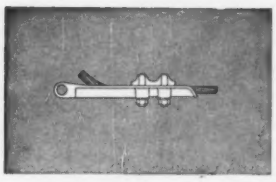
United States Steel

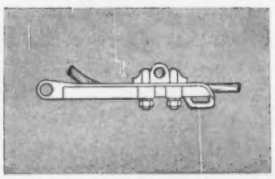
This mark tells you a product is made of modern, dependable Steel.

BETHEA CLAMPS WITH A BUILT-IN SAFETY MARGIN

Millions of Bethea Clamps have been supplied to electric utilities in this country and abroad. All are designed, tested, produced and guaranteed to meet the most rigid industry requirements.

For example, Bethea straight dead end clamps offer unusual effectiveness and economy—for every application. From two U-bolt standard styles with superior holding power, to multi U-bolt "specials" for greased core conductors, all have been designed for easy installation and hot workability. Materials are 356-T6 aluminum alloy body and keeper, high strength steel hardware and stainless steel cotter pins.





A dead end for every general and special application—
Write for catalog and Pittsburgh Testing Laboratory Data.

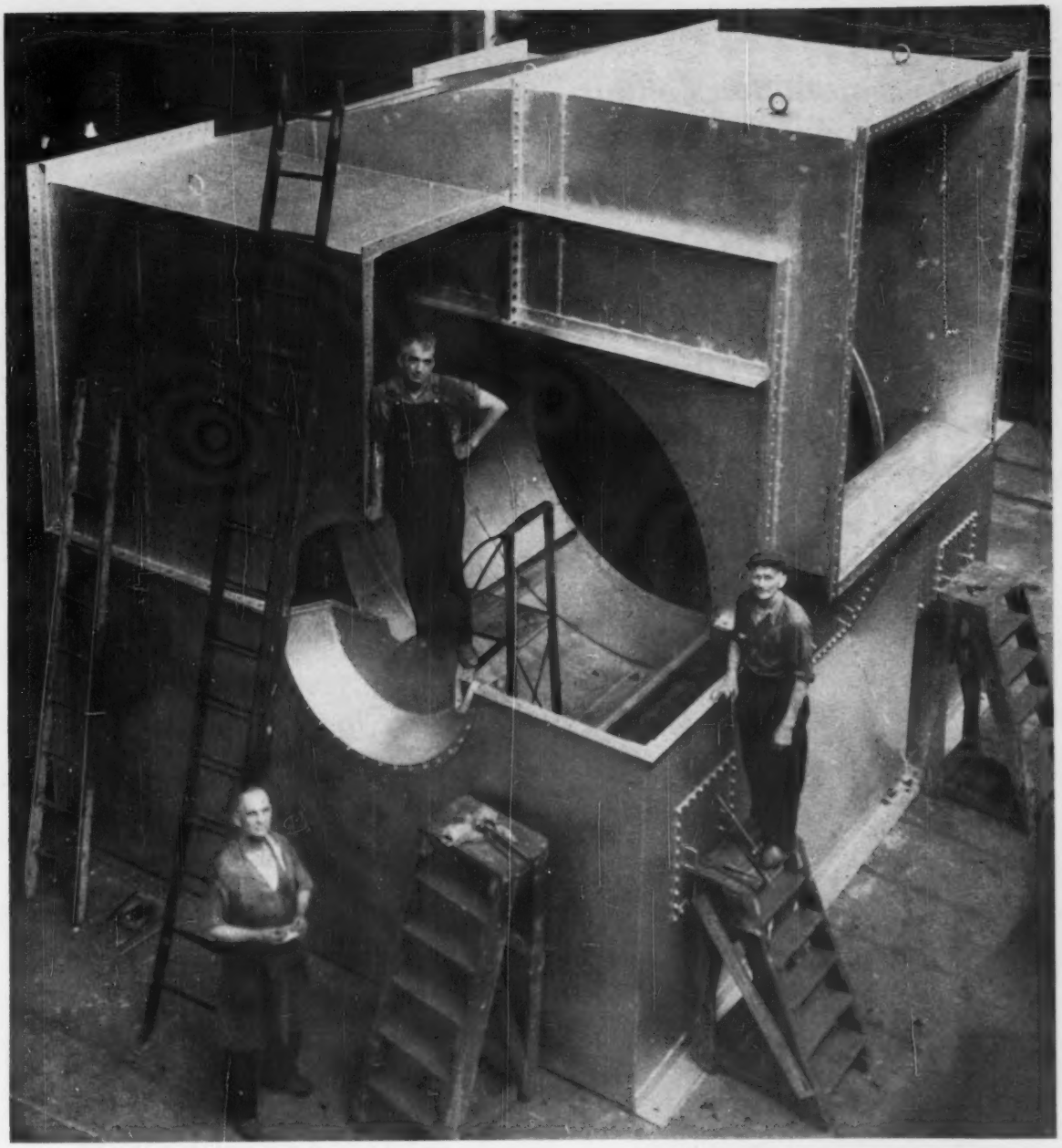
QUALITY CABLE FITTINGS

1950 1960
10th YEAR OF SERVICE

A BETTER WAY FROM . . .

Bethea COMPANY, INC.

P. O. BOX 1407 — BIRMINGHAM, ALABAMA

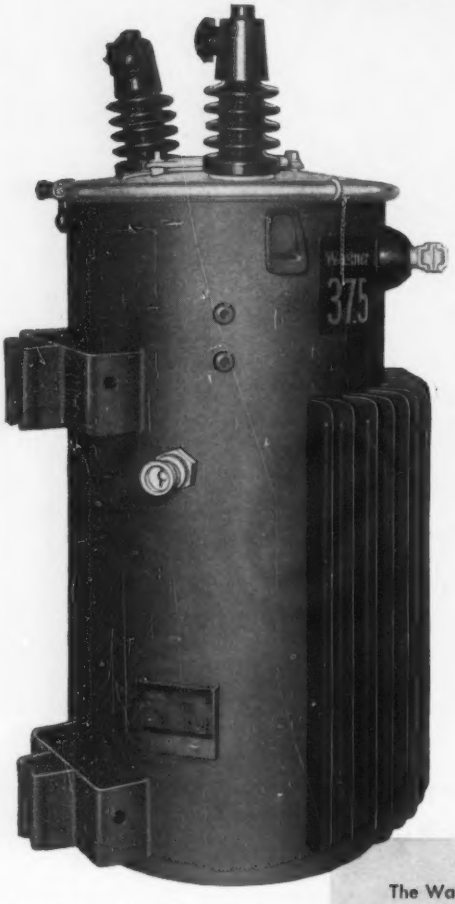


You wouldn't buy a bargain basement parachute... or a cut-rate big game rifle...

Don't choose less than Clarage quality for your mechanical draft service. With anything as vital as uninterrupted operation, it pays big dividends to get the best in equipment. Clarage, a specialist in building forced and induced draft fans, offers you equipment having a long-standing reputation for long-lasting service. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

Up-rate distribution voltage with minimum service interruption with the

SERIES MULTIPLE SWITCH ON WAGNER® TRANSFORMERS



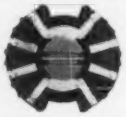
The switch is available on transformers with these high voltage ratings: 2400 X 7200, 2400 X 7620, 2400 X 7970, 4800 X 7620, 4800 X 14400, or 7200 X 14400. These dual-voltage units have losses and performance values comparable to single-voltage units of the higher voltage, and are insulated for the BIL of this voltage for positive protection against puncture, flashover or lightning failure.

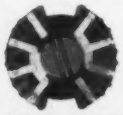
For use on systems that will be uprated, Wagner can furnish 5 through 167 kva dual-voltage singlephase conventional transformers or 5 through 100 kva protected transformers equipped with a series multiple switch. The switch permits the uprating of an entire section of a distribution system at one time. The line need be deenergized for only the brief time necessary to change the switch to the higher primary voltage rating. The externally-mounted weatherproof cap is removed, reversed and used as a knob over the switch shaft to rotate the switch to the alternate position. Safety is positive; the knob cannot be removed unless the high conductivity switch contacts are in full operating position. It is not necessary to change the terminal board connections. The cover stays on . . . oil is not contaminated.

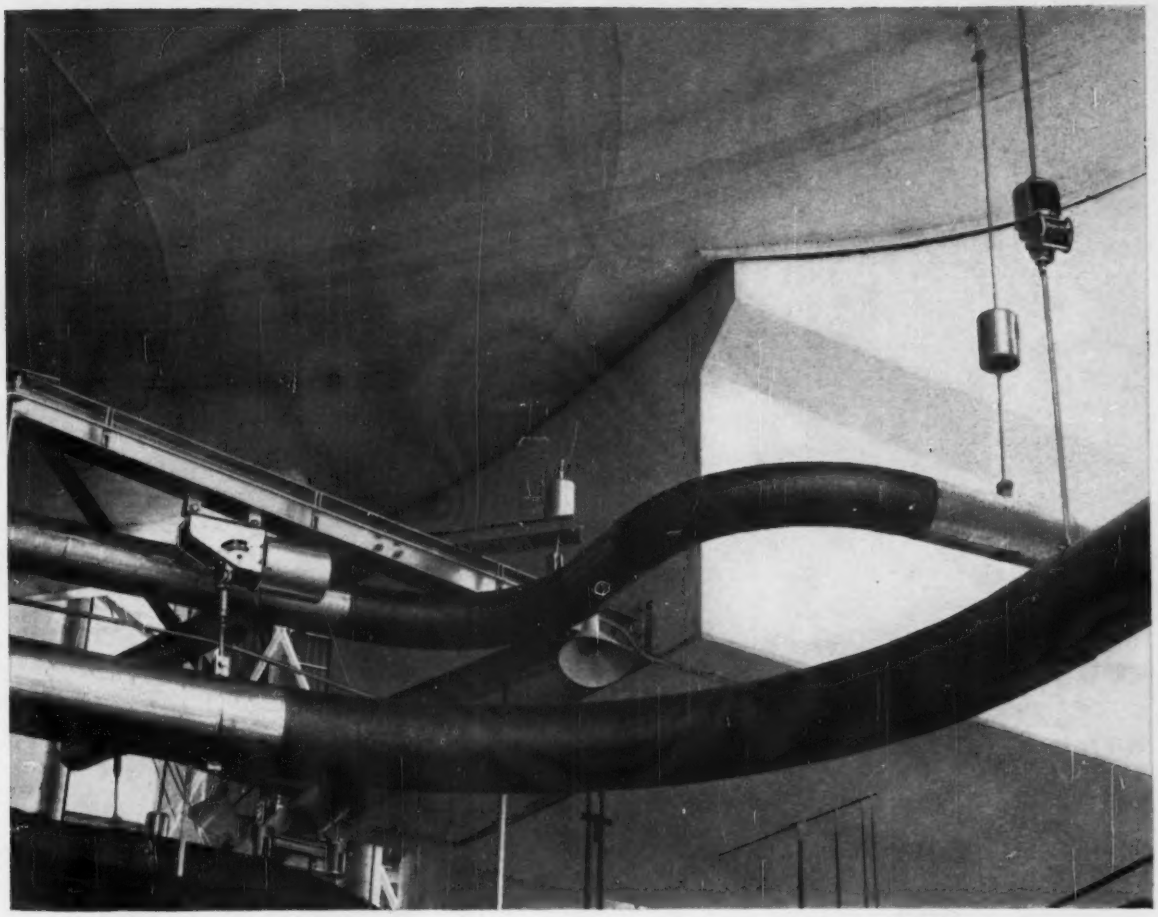
Wagner Electric Corporation
6456 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

WT60-21

The Wagner® Series Multiple Switch is a rotary-bridging two-position switch with ribs between its eight wiping-action contacts for extra creepage. All eight contacts are used for an odd series multiple, while only six contacts are required for an even series multiple . . . two pairs of contacts are jumpered. Solid mounting of the switch on the tank wall eliminates shaft alignment problems and allows fast, sure operation.


SERIES POSITION


MULTIPLE POSITION



Grinnell Spring Hangers support the pipes carrying steam from the heat exchangers to the turbines.

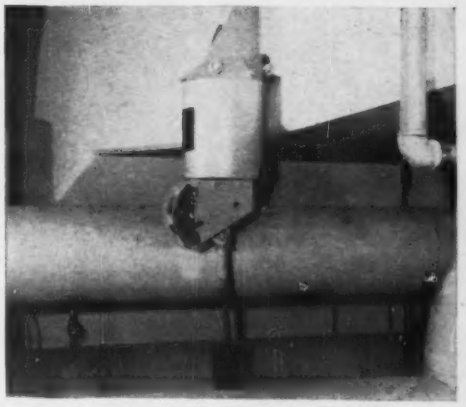
Grinnell Hangers cradle high-pressure piping at new Yankee Atomic Power Plant

At the new Yankee Atomic Power Plant in Rowe, Mass., uranium fuel in the nuclear reactor keeps the water which flows through the reactor at about 500°F. This pressurized water, at 2,000 pounds per square inch pressure, transfers the heat through piping to a steam generator where steam is produced for running power turbines.

Piping that undergoes such high pressures and temperatures must have rugged, *reliable* support. Chosen for this tough job: Grinnell Pipe Hangers!

Grinnell Constant Support Hangers are used where reactive forces at terminal points must be kept within specified limits. Grinnell Variable Spring Hangers are used where piping is subject to vertical movement and does not require a constant support type.

For a complete line of engineered pipe hangers and supports . . . for skilled advice and assistance . . . for experienced field engineering service . . . call on Grinnell Company, Providence 1, Rhode Island.



Turbine extraction lead gets support from Grinnell Constant Support Hanger

GRINNELL AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Pipe Fittings, Valves, Pipe Hangers, Prefabricated Piping, Unit Heaters and Piping Specialties • Branch Warehouses and Distributors from Coast to Coast

This mark tells you a product is made of modern, dependable Steel.

Same capacity

Same distance

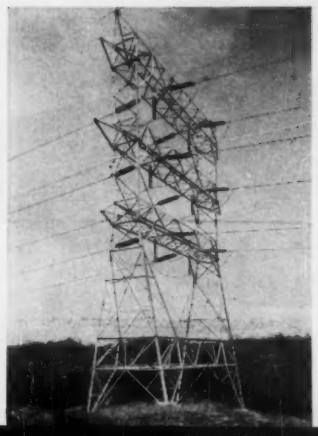
Half as many towers

Consolidated Edison's new 4-circuit transmission line from Millwood, N. Y., to the Buchanan substation in Westchester County had to be routed through a residential area, demanding minimum tower congestion on the right-of-way. To achieve this, American Bridge, in cooperation with Consolidated Edison, designed and fabricated a special single-structure, 4-circuit tower.

The new towers, 56 in all, do the same work as 112 standard double-circuit towers, with construction costs being cut appreciably. When completed, this line will draw power from Consolidated Edison's Atomic Energy Plant at Indian Point, New York.

American Bridge, the world's leading transmission tower specialist, has designed towers to carry the highest voltages in the world, towers to support the longest spans and towers that will take the heaviest loads. We have the experience, the engineering know-how, and the fabricating and testing facilities to design any type of steel tower to meet your requirements. For recommendations based on your requirements, write American Bridge Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS is a registered trademark



American Bridge Division of United States Steel

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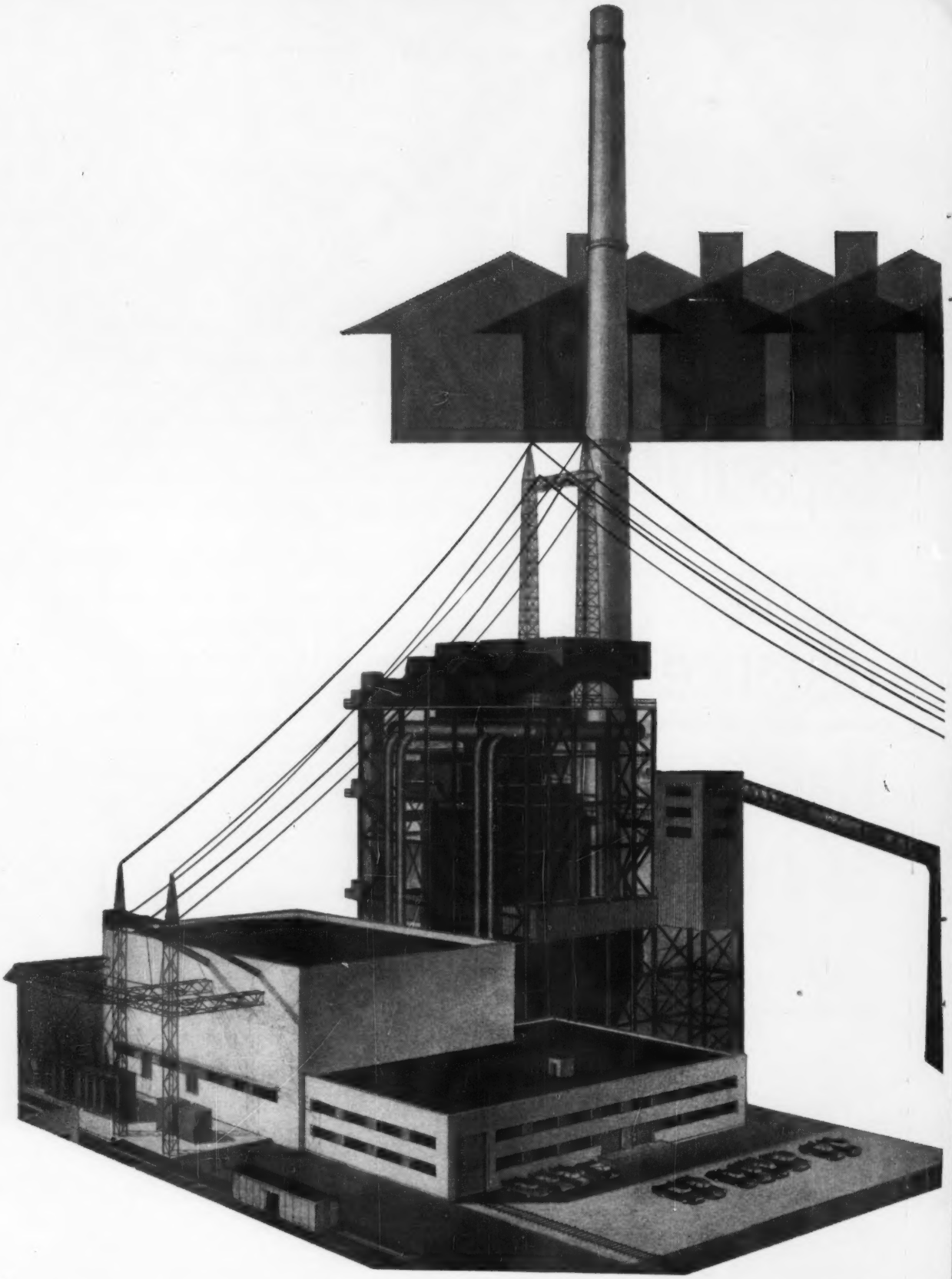
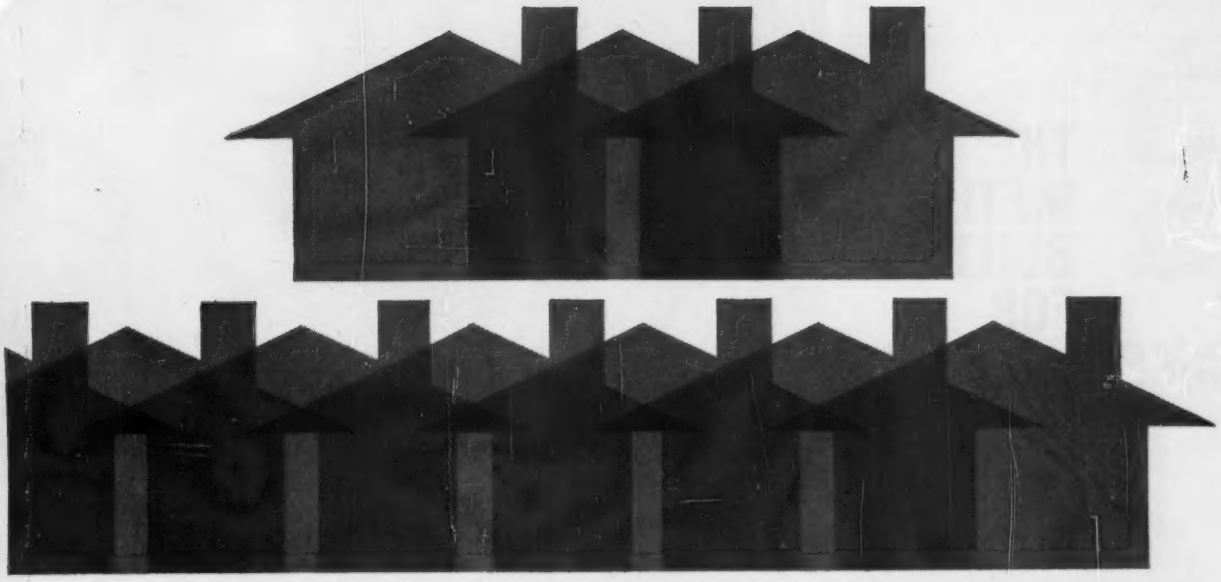
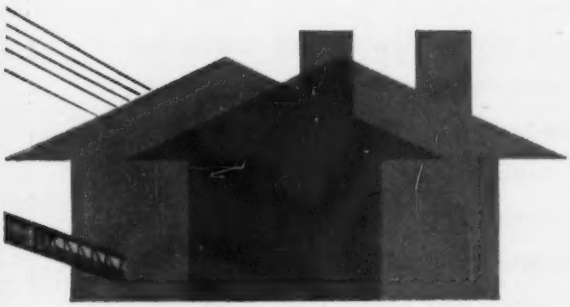




Electricity for an additional 130,000 homes ...without burning an extra ounce of coal!



The addition of two new Universal Pressure® Steam Generators —one now on-the-line at the American Electric Power System's Breed Plant, the other under construction at AEP's Philip Sporn Plant—marks a major milestone in the expansion of power utilities to meet America's surging demands for electricity.

Together, these units will provide steam at supercritical pressures (3500 psig at 1050 F/1050 F/1050 F) to generate about eight billion kilowatt hours of electricity annually. Each of these steam generators will consume a carload of coal every twenty minutes. Because of the improved cycle efficiency of these units, electricity generated from this fuel will be sufficient for the annual needs of over two million average American homes—130,000 more homes than could be supplied by burning the same amount of coal in the best generating stations now in operation in the world.

Net power of these stations is about twice that produced annually at Hoover Dam . . . yet cost of putting these new plants on stream (per kilowatt of electricity) will equal about ⅓ that of building a new Hoover Dam today.

Expansion is the measure of the future — and products of Babcock & Wilcox engineering and research will pace much of the nation and the utilities industry.

For more detailed information on the UP® Steam Generator and other B&W power generating systems and designs write: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

G956-A

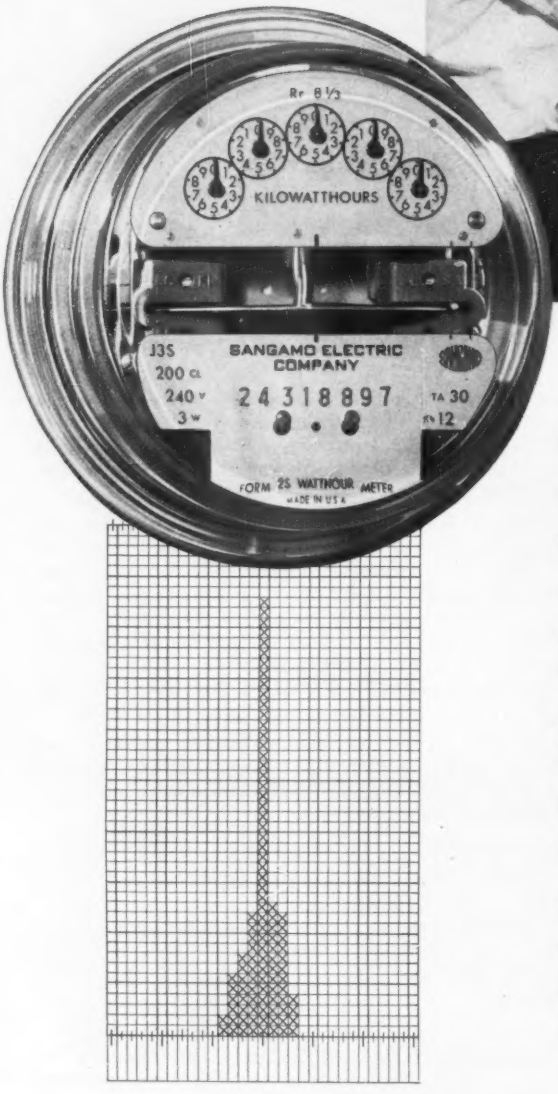
B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

true MAGNETIC flotation

J3 THE METER BUILT FOR SAMPLE TESTING



Utility meter departments employing sample acceptance and service tests can depend upon the good $\bar{x}$ and σ results of Sangamo's new J3 to assist in reducing operating costs.

tremendous teammates

Sangamo J3 meters and sample testing are tremendous teammates. The J3 was designed with sample testing in mind... Its original accuracy and dependability will remain constant for many, many years. This goal was achieved by combining J3 True Magnetic Flotation with highest torque, slowest speed, high surge resistance, and a balanced moving system to give calibration stability.

Successful acceptance and service sample testing programs require the high sustained accuracy and long term service dependability inherent in Sangamo's new J3 meter.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

JM60-10

Electrical World

DECEMBER 26, 1960

Editorial Comment

The Passing Year Casts Its Light on Industry Problems

The electric utility industry, in 1960, weathered a year of change, controversy and confusion. We find little reason to doubt that the same description won't fit 1961 when the time comes to look back at it.

A working review of the year just past and a hard-headed projection into the coming 12 months, for our editors, provides valuable illumination on problems we believe of particular significance. Having completed just such a broad analysis (see p 55), we've selected a few problems that seem to cry for more attention than is now being given. Following are some of these problems to which we expect to pay considerable detailed editorial attention during the year ahead.

• **Growth of the federal government in the power business.** Always a potent threat to investor-owned utility survival, this has seldom been more real. Key to control of this growth, we believe, is a bold, energetic approach to push pool and interpool integration to *utmost* economic limits. Inflexible personalities, fear of federal regulation, and roadblocks to finding mutually acceptable financing formulas for the necessary heavy tielines and huge generating plants, must be swept aside in the common interest. In comparison with this problem, others facing the industry seem pale.

• **Computer-controlled generation and system plant.** Activity here is running somewhat ahead of actual need. But it bids to remove operating limitations before they occur. We urge utilities to enter this pioneering field—or at the least, study resulting data seriously.

• **Public reaction to radiation hazards, stream and air pollution, and underground distribution.** We believe these areas will see increasing public pressure to correct real or imagined abuses by utilities. Foresight, embodied in active, successful experimentation, can head off this pressure before it becomes intolerable. Strong *and frank* cooperation with public authorities is needed, starting now.

• **Resolution of international standards for EHV levels.** This problem until now has been largely ignored. But the accelerating pace of international rapport at technical and commercial levels militates for agreement among nations. The world already is too small for petty disagreement on a matter which can ease equipment development and reduce costs significantly.

• **Distribution system planning.** Engineering of economical distribution plant begs for early, intense use of the high-speed computer to determine optimum system growth patterns and to pinpoint areas needing greatest cost-reducing effort. Each utility, we believe, should analyze its record-keeping of trouble and load growth, to tailor old and new data for computer use and handling.

• **Resolution of distribution transformer controversy.** With so much investment in distribution transformer plant, the controversy revolving around ratings and loss ratios must be settled quickly.

• **Electrical equipment pricing.** This old problem is acute again, with the price-level pendulum in full swing. Though the swing always reverses eventually, cool utility heads should not increase its amplitude by conscious action. Heavy attack on manufacturing costs, restraint against over-building productive capacity, and expert salesmanship is dictated for the suppliers, who, in our view, largely hold their futures in their own hands.

Gov Orville Freeman Named Secretary of Agriculture

President-elect John F. Kennedy has picked Minnesota Governor Orville Freeman for a cabinet post affecting power issues. Freeman was picked last week as Secretary of Agriculture, where he will have nominal authority over rural electrification policies.

Freeman is on record, as is Kennedy, to maintain the 2% REA interest rate, and to continue federal funds to aid co-ops in carrying out the "area coverage" theme of the REA Act. NRECA General Manager Clyde Ellis praised the appointment, claiming, "Many Americans concerned about the future of the rural electrification program welcome the news of Gov Orville Freeman's appointment . . ."

Kennedy's choice for REA administrator hasn't been announced. Present REA Administrator David Hamil says he doesn't plan to stay on, although he has six more years tenure in his ten-year post. Hamil has said he is a "political realist," and probably wouldn't continue under a Democratic administration. A rumor persists in Washington, however, that Hamil may be urged by Kennedy to stay on.

Kennedy also has decided to appoint James K. Carr, California Water Board chairman, as Undersecretary of the Interior. Earlier, Kennedy had picked Arizona Congressman Stewart Udall as Interior Secretary. Both Udall and Freeman are sized up as "liberal in the Kennedy image" by Washington observers. Carr was instrumental in pushing through the huge $2-billion California water bond issue in the November general election.

McCone Resignation Raises Speculation on AEC Chairman

Selection of a new Atomic Energy Commission chairman takes on new interest following the announcement of John A. McCone that he definitely plans to step down from the number one commission job on Jan. 20.

McCone will return as owner of the Joshua Hendy West Coast Shipbuilding & Shipping Co to direct the activities of that firm.

McCone's resignation plans heighten speculation over whether the incoming AEC chief may be Robert M. McKinney, editor and publisher of the Santa Fe *New Mexican*. McKinney carries the strong support of Sen Clinton P. Anderson (D-N.M.), the outgoing chairman of the Congressional Senate-House Atomic Energy Committee. McKinney was the first permanent representative of the US to the International Atomic Energy Agency in Vienna, and also a former Assistant Secretary of Interior in the Truman Administration.

Nomination of the chairman of the 120,000 employee Commission, which operates a physical plant representing a $7.5-billion capital investment, is under study by President-elect Kennedy this week. An appointment to additional vacancy on the five-man Commission is also to be made by Kennedy.

In addition to McKinney, others who have been mentioned as candidates for AEC chairman are Harrison Brown, professor of geochemistry at California Institute of Technology, and Jerome Wiesner, Massachusetts Institute of Technology professor now serving on the President's scientific advisory committee.

New York Utilities Plan Power Sale

A proposal under which two New York State utilities would sell General Public Utilities Co at least 100 Mw of firm power for a two-year period has reached the preliminary agreement stage. Niagara Mohawk Power Corp and New York State Electric & Gas Co, who recently signed a memorandum of agreement with GPU, will each furnish half the power at a rate of 4 mills per kwhr and a $12 per kw-year demand charge from July 1, 1963, to June 30, 1965. The power will come from excess steam generating capacity owned by the two N.Y. companies. Allocation of the power among the four GPU subsidiaries—Pennsylvania Electric Co, Metropolitan Edison Co, New Jersey Power & Light, and Jersey Central Power & Light—has not been determined.

The sale will not involve any new transmission lines but will use those already in existence or planned for construction between now and 1963. Existing transmission includes a 115-kv line between Niagara Mohawk's western division at Falconer and Penelec's Warren station, and three 115-kv lines from New York State E&G's Binghamton-Elmira area to the Lenox-Towanda-Mansfield area of Penelec in northeastern Pennsylvania. A 230-kv tie between Niagara Mohawk's 230-kv and the western part of GPU's 230-kv system has already been planned. Load control on the generation of GPU companies and other interconnected systems will help control the tie line flow. GPU is a member of the Pennsylvania-N. J.-Maryland interconnection. The two N. Y. companies are part of the Canadian-US eastern interconnection.

May Change Design of A-Plant

Steam separators being considered by AEC for plant to be operated by Los Angeles and Pasadena and owned by AEC

The Atomic Energy Commission may now decide to install internal steam separators to get lower cost nuclear power from the advanced type, 50-Mw boiling-water reactor which the government will own, but which the cities of Los Angeles and Pasadena, Calif., will operate.

The Commission selected Allis-Chalmers Manufacturing Co last month as the firm to build the reactor after re-evaluation of construction proposals resulted in cancellation of the construction job previously awarded to General Electric Co.

Commission Must Make Decision

It is now up to the AEC to choose internal over external steam separators under the $10.8-million Allis proposal. It is expected to be made by the month's end. The Allis design proposal included both types based on proved performance data, but strongly recommends selection by AEC of internal equipment.

Steam separators inside the reactor pressure vessel, Allis says, could better be scaled-up to a 300-Mw full-size nuclear power plant. Fabrication costs are likely to be exorbitant for the scaled-up external separator "daisy" design, with each separator flowering out as a petal from the central, stamen-like pressure vessel housing the uranium-fueled core.

The Los Angeles-Pasadena reactor will include between 24 and 28 internal separators with a capacity of 1,550 gpm of coolant per separator. The same type separator, but later extrapolated to the 300-Mw commercial size reactor (72 to 77 separators in all) would handle 3,200 gpm. A chevron blade steam drier is to be built into the head of the separator.

Under additional options, the Commission may accept the following reactor features proposed by Allis: in-core fuel element failure detection system; in-core neutron flux monitoring system; power-load-following control system.

The Allis-built 50-Mw reactor will be described in the technical literature as an improved cycle (high temperature and pressure), high-efficiency power plant. The design hikes the heat-to-electric energy efficiency to 31%—up from normal boiling water reactor efficiencies of about 26%. Allis plans to subcontract fabrication of an appreciable number of the components for the reactor, including the pressure vessel and fuel elements.

Design Specifications Listed

Fixed design specifications are: electrical power output—53 Mw; thermal power output—162.4 Mw; fuel rods—3% enriched uranium, stainless steel cladding; moderator and coolant—light water; control rods—Boron steel (hydraulically and electrically driven); power density—36.6 kw per liter of core; pressure—1250 psig; temperature—574F at the turbine.

Site and generating equipment for the nuclear power plant are to be furnished by the two cities at a cost of about $5 million each. Invitations for the generating equipment are expected to be issued soon. Allis will also bid on furnishing the generators.

Site chosen for the reactor is a sparsely populated 1,100-acre tract about 25 miles southeast of Los Angeles, near the old mining town of Saugus. Site preparation work is now underway.

Supergrid Voltage Hike Planned by Great Britain

Britain's Central Electricity Generating Board has announced that it will increase the operating voltage of England's supergrid from 275 to 400 kv. The move will boost the grid's capacity from 1,200 Mw per double-circuit line to 2,000 Mw and so reduce the number of lines to meet Britain's mounting power needs.

CEGB's plans sight on 1965 as the date for the first 400-kv line to be in commercial operation. Orders for the conversion are to be placed in "the very near future." An experimental 380-kv circuit is expected to come into service in 1962.

The voltage step-up is possible, the Board notes, because the majority of existing supergrid lines were originally designed with an eye to future conversion. All that will be necessary now is to reinsulate the lines. However, for new main trunk lines, the Board plans to introduce a new tower design, carrying four conductors per phase, compared with two per phase on the 275-kv lines. This will mean that the towers will stand about 20 ft taller than existing units.

The Board grants that, for the transmission distances involved in the UK, there is "no great economic advantage to be gained" with the higher voltage lines. But the technical advantages and the reduction of lines needed in the country are called significant enough to make the step-up worthwhile.

Nuclear Plant Is Designed For Future Output Increase

The largest boiling-water nuclear power plant in Europe, SENN's Garigliano nuclear power station, is being designed so that its electrical output can be eventually increased by 50% should the plant's owners, a group of Italian utilities, later decide to boost its rating.

General Electric Co's atomic power equipment department is designing the nuclear system.

Garigliano station, which will use uranium-oxide fuel, is being built 35 miles north of Naples. It will initially have an output of 150 Mw.

After the station is operating, SENN will determine the feasibility of increasing the electrical output.

Columbia River Stirs Family Fight

Financing terms and control of projects stymie agreement between federal officials and provincial government

Dominion-provincial differences on financing Columbia River projects broke into open rift when Federal Justice Minister Davie Folton and British Columbia Premier W. A. C. Bennett were unable to meet in BC. Folton returned to Ottawa after accusing Bennett of completely falsifying the picture. Bennett, he said, had decided to reject Ottawa's offer to advance $172 million for the $450-million Columbia scheme as a partner in a joint venture. Folton branded as "untrue" reports that the federal government demanded a "continuous share" in profits from the Columbia development.

It has become clear that a federal-provincial fight looms over the project financing after the whole subject flared into bitter conflict between Folton and Bennett in a series of weekend incidents that began when Ottawa announced the contents of a letter from Federal Finance Minister Donald Fleming enunciating Ottawa's offer, which Bennett rejected.

Bennett said BC would go it alone on the Columbia because Ottawa's offer would saddle the province with an extra $40 million in costs, and it meant Ottawa would set up a new joint super agency to be in charge of the whole project.

Folton Defends Ottawa

Folton, in BC with his federal colleagues for technical talks on the US-Canada Columbia treaty, was unable to get a face-to-face meeting with Bennett to heal the rift. He charged the Bennett government had not read or considered the new Ottawa proposal before rejecting it. In an interview before leaving for Ottawa, Folton said he would ignore the impasse with Bennett to the extent that federal negotiations with United States would continue, but he indicated the burden of negotiation now lays with BC.

In Vancouver, Folton termed the federal offer "the most generous ever made by a federal government to any province for assistance in the financing of a hydroelectric development."

He reiterated highlights of Ottawa's offer.

"The offer is to provide half the capital cost of creating the storages and construction of the dams necessary to bring the treaty into operation. It is estimated the federal contribution would be over $170 million. This is what Bennett has just rejected.

"It is not a loan to British Columbia. It is a new and imaginative concept in which the federal government would invest in partnership with British Columbia monies necessary to bring into being a self-liquidating project. It is not an offer to the province to reimburse a share of the cost after the province has had to raise the whole. It is an offer to advance our share of the investment as contracts are approved and money becomes necessary in accordance with construction schedules.

"As it is an offer of an investment, not a loan, we have suggested the federal government would be in the same position as any investor, including the province, with respect to repayment. We would only expect repayment of our investment after the project becomes self-sustaining and then only to the extent that there are revenues left after operating costs are met. We have asked only that we receive from net revenues the same share as our investment bears to the total capital investment to be applied in repayment of our investment. After repayment in full we would, of course, have no further interest in the proceeds of the operation and have not asked for any continuing share.

"Regarding interest rates, we have only asked that our investment carry interest at the same rate as would be determined by the going market rate at time investment is made. Here again we have only asked that we be in the same position with respect to our investment as the province or any other investor.

"Our offer was made subject to a number of variations, with the province having the right to decide which form they desired. All of these possibilities have been ignored by the Premier. We have stated that if the province wished it, we would be prepared, instead of paying in a cash advance, to guarantee a proportionate share of the bonds issued by an appropriate entity. Or again we would be willing to undertake to purchase a proportionate share of bonds issued by the entity and not subscribed for by the public. In any case, under none of the variations or combinations that we have offered would there be a loan to the province or any financial obligation by the government of British Columbia with respect to our share.

"The catalog of falsifications of this offer made by the Premier of British Columbia is too long to permit me to discuss all of them.

"The Premier persists in referring to it as a loan at the federal government borrowing rate plus ⅛th of 1%. That is as false as it could be. The letter makes it clear that it is false, as it is an investment which we will advance as construction schedules require and the letter contains no mention of any extra ⅛th of 1%. Indeed the letter makes it specific that the interest rate we will expect on our investment will be determined by the rate at which the entity could borrow from the market at the time the investment is made. Nothing could be more practical or economical with respect to the financing of a self-liquidating project.

"Premier Bennett has tried to mislead the people of British Columbia into believing that the federal government insists on a share of the profits for the duration of the project.

"Premier Bennett says the federal offer is made on the basis we would take physical control over operation of provincial resource. It could not be clearer that nothing of the sort is contemplated. We accept designation of BC Power Commission as the entity to have responsibility for the physical aspects of construction and operation. We have asked for representation on a joint entity with BC which would have some voice

in Canada

in the over-all supervision to ensure that construction is complete, according to proper design and on schedule, and that operation is carried out in accordance with the treaty.

"After all, the federal government is the party to the treaty with United States, and it is the government of Canada which will assume direct and extensive international obligations to see that dams are constructed in certain locations according to certain timetables, and are capable of accomplishing definite objectives. These obligations we cannot escape and we must therefore be in a position to ensure that they are discharged. In short it is the government of Canada that has made the treaty possible, it is the government of Canada that will be bound under the treaty and therefore has an obligation, both internationally and to the people of Canada, not to allow itself to be placed in a position where it is powerless to discharge those obligations.

"There is one other feature about which we are most concerned. Our whole object in this long and arduous task of negotiations has been to secure a Columbia River agreement that will produce untold benefits to BC in terms of abundance of power at low cost. We are determined to see that this objective is achieved and that the benefits go to the people for whom they were designed, and that we shall be in a position to see this happen, so that the beneficiaries will not be just some other pet project of the Premier, but the consumers of power in British Columbia."

Folton's last remark was a reference to the Peace River development.

Earlier, Premier Bennett, in rejecting the offer, declared BC can and will finance the Columbia project by itself if necessary. He termed the proposed joint agency a "fifth wheel," and insisted the BC Power Commission would be the only Columbia authority. "Under our constitution, property and civil rights are the sole prerogative of the province."

Bennett said he is still hopeful Ottawa will make an outright grant. If not, he said, BC will raise the money mainly by long-term bonds on the open market.

The Premier put BC's position in long bargaining into perspective. BC has always accepted its responsibility to develop the Columbia, he said. "The government of Canada was asked to negotiate those international questions, mainly concerning downstream benefits, which required settlement by the United States before the development could proceed.

"Additionally it was asked to make a financial contribution in line with its policy toward similar projects elsewhere in Canada," Bennett concluded.

NIPSCo Adopts Slim-Waist 138-Kv Tower

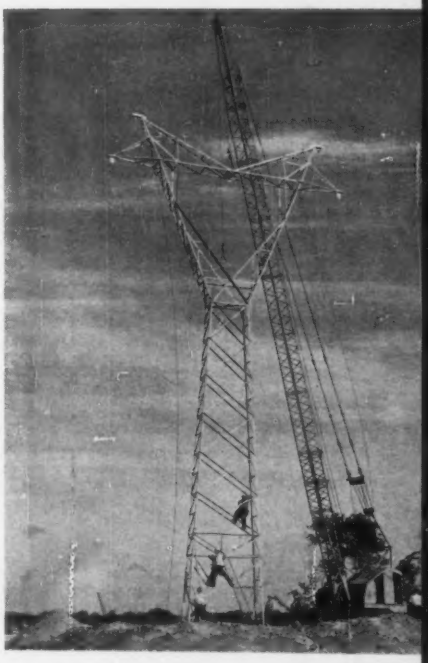
A no-broken-wire assumption is the key to the design of a new lightweight single-circuit tower for 138-kv lines adopted by Northern Indiana Public Service Co. Designed by Sargent & Lundy Engineers to NIPSCo's specifications, the new narrow-waist, narrow-base tower is being used in a 26.5-mile line from Plymouth to Warsaw, Ind., and a 1.6-mile line from the company's new Bailly Station to Bailly Substation. This steel tower competes favorably with wood H-frame structures on a cost-per-mile basis.

The new tower has these characteristics: average weight, 5,700 lb; height, 87 ft; and dimensions of 4 x 11 ft at the base. The lightweight towers will support a maximum span of 1,370 ft of 397.5-MCM ACSR conductor and a 1,070-ft span of 900-MCM ACSR conductor. They are designed to withstand NESC heavy loading with a 4-psi wind load and ½ in. of radial ice. According to NIPSCo practice, conductor is sagged to a maximum of 50% of ultimate tensile strength. In building the two lines, the towers are being completely assembled on the ground.

In the design of the tower, consideration was given to the selection of design loading conditions comparable to anticipated loads rather than for every remote provision. Extensive studies were made of various configurations to achieve optimum strength with the least material, resulting in the use of high-strength steel at advantageous points.

During a recent three-day test at American Bridge Co facilities in Pittsburgh, Pa., the new design was tested to over 100% of full operating load without failure. The test tower stood 102 ft high and weighed 6,715 lb. It was able to withstand simultaneous applications of 14,400 lb vertically (plus its own weight) and 12,190 lb transversely. After the tower successfully passed the operating load test with no visible sign of distress in any member, it was tested to destruction transversely, failing at a 5% increase in transverse load.

After the failure, all damaged members were replaced and the tower was tested to destruction longitudinally with no vertical or transverse loads. It failed at a longitudinal load of over 4,000 lb.



GROUND ASSEMBLY is used on new tower in building two 138-kv lines in Indiana. Average tower weight is 5,700 lb; height is 87 ft

Pumped Storage Planned for Oklahoma

A 200-Mw pumped-storage project for peaking power is being planned by Public Service Co of Oklahoma on Sand Creek, adjacent to the Corps of Engineers Keystone Reservoir on the Arkansas River. Permission to go ahead with the $22-million project was asked of the Federal Power Commission.

This will be the only hydroelectric project on the PSC system, which now has 800 Mw of steam-electric generating capacity. An additional 175 Mw of steam-electric capacity is scheduled for service in the spring of 1961. Target date for completion of the pumped-storage project is April, 1964. The Corps of Engineers estimates that Keystone Dam will be closed by May, 1964, or earlier.

Peaking capacity from the 200-Mw Sand Creek project will be used by PSC, or will be sold to adjacent systems for peaking use. Savings of the project are estimated at from $145,000 to $209,000 annually compared with the cost of installing steam-electric units of similar size. Four 60-Mw transformers will feed the project's output to PSC's system over a 19-mile, 138-kv line tying into the Tulsa Station-Sand Springs-Bartlesville 138-kv loop.

The development will include a 160-ft high earthen dam, nearly a mile long, which will create a 450-acre lake to hold 7,500 acre-ft of storage. Four 50-Mw pump-storage turbine-generators will be located in the dam. The units will operate as pumps about ten hours in the night to fill the storage lake from Keystone Reservoir.

Water level in the Sand Creek Reservoir will fluctuate about 200 ft over a 24-hr period. The conservation pool of Keystone Reservoir is to be at elevation 712 ft, which is 248 ft below the high water level in Sand Creek Reservoir.

Dateline . . . San Francisco (*Continued from page 5*)

to develop nuclear prestige through scientific and industrial accomplishments. To this end, the Commission has constructed a vast, $7-billion-plus complex of federally-owned facilities and oversees their operation. In this plant, manned by 120,000 employees, a variety of programs is initiated, supported and guided under government contracts.

The promotional function comes from the direction in the Act for AEC to foster and establish programs designed to achieve widespread participation by private business in the development of nuclear energy for peaceful purposes.

The promotional aspects were to help industry bridge the gap between government monopoly and a self-sufficient investor enterprise.

The regulatory function (including rule-making, licensing, inspection and enforcement) relates to protecting the health and safety of the public from atomic hazards. The major element of the Commission's regulatory program, of course, is the control of investor-owned reactors.

Vesting these functions in the same body could not fail to create these anomalies:

• As an operator, AEC invariably competes against the industry it is promoting by engaging in parallel production, service and developmental activities.

• AEC must regulate the very industry it is promoting. After doing everything it can to encourage construction of reactors, for example, including actual financial assistance grants, the Commission must then sit as judge as the reactor winds its way through a licensing procedure. One of the consequences could be the possible sacrifice of public safety. This issue is at the heart of the Fermi fast breeder case now before the US Supreme Court.

• A burdensome licensing system has been permitted to grow up, perhaps to cushion the Commission, which acknowledges its conflicting dual regulating and promoting role. Hearing examiners are now helping to establish licensing policy. Judgments of the AEC staff and the Advisory Committee on Reactor Safeguards have made hearings longer and greater in number than originally contemplated.

The Joint Committee on Atomic Energy is now conducting a study of the licensing of facilities; the AEC staff is conducting a more limited review of experience built up in individual licensing cases; the University of Michigan Law School's atomic research project has just concluded a major analysis of AEC organization. The entire matter has been brought to the attention of President-elect Kennedy's advisor on regulatory agencies, James M. Landis.

One of the key recommendations which the Congressional study will make is a much sharper separation than now exists between the Commission's regulatory functions and its operational and promotional functions, to guarantee detached and uninfluenced reactor safety evaluation and licensing. Some of Kennedy's campaign advisors on energy resources continue to advocate the stripping away of all of AEC's regulatory duties and installing them at the Federal Power Commission.

The University of Michigan envisions splitting AEC into two agencies: an Atomic Energy Administration, with a one-man administrator, would conduct AEC's operational and promotional functions in nuclear development. An Atomic Energy Board, with three members and the administrator sitting in, would become responsible for safety regulation, including rule making and deciding individual licensing cases.

LOAD-FLOW PROGRAM is checked out on IBM 1620 computer as delegates to PICA at St. Louis observe

MODEL of the Bendix G-15 data-processing system is inspected by delegates to conference on computers

AIEE Told of Computer Progress

PICA St. Louis conference hears computer programs have been extended, refined, though not yet fully exploited

Full advantage of the digital computer as an engineering tool still awaits exploitation, the American Institute of Electrical Engineers was told in November at St. Louis, Mo.

Yet their growing understanding of computer techniques is enabling engineers to see more clearly the relationships among many design and operational factors and to include these in electrical supply system economic optimization studies, K. M. Smith and E. L. Michelson, Commonwealth Edison Co, told the second AIEE Power Industry Computer Application Conference. Their remarks could just as well be extended to all fields of utility engineering and operation explored by more than 260 delegates, such as new and improved digital computer techniques for short-circuit studies, for cost of future and present generation, for complete power plant automation, for system analysis, and for transmission operation and design.

More precise equations in a new IBM 704 computer program give more accurate results in calculating distribution-circuit sequence impedances at little extra solution time, according to R. C. Ender and G. G. Auer, General Electric Co, and R. A. Wylie, Niagara Mohawk Power Corp. They described programs for distribution system analysis and design.

Their first program, called Program A, calculates positive and zero sequence impedances of overhead lines from circuit characteristics. Program B calculates maximum and minimum fault currents at specified points on a radial primary circuit from the output data from Program A, along with voltage, source impedance, and fault impedance data. Both programs handle up to 99 lines and 500 line sections. Computer running time for Program A calculations for a circuit of 37 lines and 53 line sections was about 2.8 min; for Program B about 3 min.

Combines Outputs

A third program will use the output of Program B, together with relay, recloser, and fuse characteristics, to determine circuit overcurrent protection.

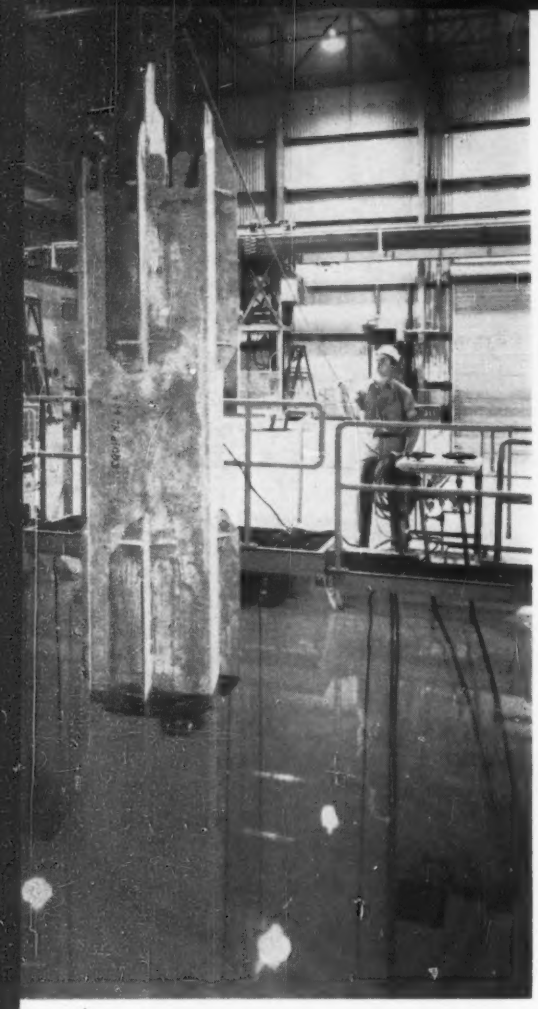
A new short-circuit program for relay studies enables an engineer to study 3-phase faults under much less restrictive simplifying assumptions than before, said G. E. Taylor and G. K. Carter, both of GE, and E. H. MacDonald, Philadelphia Electric Co. The system can be represented more accurately by considering the complex impedance of transmission lines, off-nominal ratio and phase-shifting transformers, system voltages, and load currents. The authors reported that this program will be combined with relay-setting subroutines being written by Philadelphia Electric to form a generalized protective relay program.

Program improvements and analytical extensions to digital calculation of currents and voltages in faulted networks were presented by R. W. Long, R. T. Byerly, and C. W. King, Westinghouse. They suggested that the storing and use of a transformation matrix as a table saves considerable time throughout the program. A logic method of obtaining the TZT' matrix saves 85% in time for forming this matrix. The new method requires fewer time-consuming multiplications to obtain the ZI drops for a fault condition.

The authors said that analytical extensions allow the addition of a branch between any pair of buses in a network, making possible the solution of the new network by modification of a previous fault solution. In handling multiple line outages, several lines may be removed simultaneously for a fault calculation and sequential switching of a 3-terminal line may be handled easily. It is also possible to obtain a zero sequence equivalent where it is desired to include the effect of inductive mutual coupling.

Costs of future generating units

(*Continued on page* 96)



Reactor Power Can Be

- Greater allowable core voids increase power potential
- Raised heat fluxes may also boost output
- Dual cycle shows operating flexibility
- Control rods establish good power distributions in the reactor core
- Radiation levels are less than anticipated

FUEL ASSEMBLY CASK is lowered into the fuel storage pool. Crews demonstrated they could handle fuel in such casks under water with direct visual control. In its 488 fuel channels, the core holds 67 tons of UO_2 enriched to 1.5% U^{238}

G. M. ROY, Manager, Core & Fuel Design, Atomic Power Equipment Dept, General Electric Co, San Jose, Calif.

More than a year of tests and operation at Dresden Nuclear Power Station have shown that the nuclear steam-supply system should be capable of substantially more than its rated 626 tMw (180 Mw electrical). The plant, 50 miles from downtown Chicago, went into commercial operation on the Commonwealth Edison Co system on August 1. It has exhibited excellent load-following characteristics and stability under steady state and transient conditions in the interim.

At the time of the Dresden concept and contract in 1955, several basic technical questions were unanswered because of a lack of experimental data. The information gained from measurements during operation of Dresden has given complete confidence in all of the key areas for which limits were previously uncertain. Specifically, Dresden has established these facts about operation of large boiling-water reactors:

- Reactor stability was demonstrated even at voids (steam volumes) greatly in excess of design.
- Ability to control and measure core power distribution was proved.
- Load-following performance was demonstrated as the reactor responded in a predictable, controllable and stable manner to disturbances during power operation.
- Radioactivity observed in the turbine plant during operation has been lower than anticipated.
- Feasibility of refueling and maintenance techniques were demonstrated.

Currently, Dresden is shut down for the modification of the 80 control-rod drive assemblies. Last month a drive tube, which connects the poison blade to the drive assembly, broke because of stress corrosion cracking of its precipitation-hardened stainless steel. The trouble is a material problem and modifications are underway.

The Dresden plant, a dual-cycle system (Fig 1) is a modification of the direct-cycle boiling-water reactor of the pressure-vessel type, which contains ordinary demineralized water as both coolant and moderator and in which steam generated in the core flows directly to the turbine. The dual cycle was adopted to increase the power output for a given reactor vessel and pumping plant and to provide load following.

Although previously small boiling water plants had operated successfully, extrapolation by factors of ten to 20 was required to reach the level of Dresden conditions. Basic questions existed as to instabilities that might be caused by interactions between regions within the core and as to stability of the reactor system in which the core operates as one of the units in the system feedback loop. The first concern stemmed from the realization that the core

Raised, Dresden Shows

was made up of many critical assemblies, and voids could conceivably cause shifting of power from one region to another, a condition somewhat similar to, but on a much faster period than, the xenon transient observed on other large reactors. The second concern also for possible instability of the reactor core through the closed feedback loop: reactivity change → power → temperature, hydraulics and voids → reactivity.

Dresden operation has essentially eliminated these concerns. The plant showed no instabilities or any trends of an approach to instability. This was true of both core nuclear-hydrodynamic phenomena and riser-flow phenomena. Further, following initial full-power operation, a test to determine maximum primary-steam production capabilities showed no instabilities with primary-steam flow as high as 137% of rated. Indeed, the limit of this test was the capacity of the feed pump. For these tests, voids were about 18%, nearly twice the rated value of 10% at full power.

Stability tests were conducted at each power plateau in the approach to full power to verify reactor stability and to ascertain with reasonable confidence that the reactor would be stable at the next plateau. They gave these results:

- As a central control rod was oscillated, signals were recorded by in-core instruments. With rod oscillation periods of 3.4 to 60 sec, there was no evidence of an approach to an unstable reactor operating condition.
- Spectrum examination of in-core ion chamber noise revealed no pronounced frequency peaks that would be expected if some unstable operating condition were being approached.
- Noise tests of in-core ion chambers and gamma detectors, which monitored nitrogen activity, showed peak-to-peak noise variations not more than 4%, a lower value than expected for the system. Riser flow pulsations were very small, and flow shifting between risers occurred to only a slight degree. The reactor performed in a stable manner up to rated power from both the standpoints of core nuclear-hydrodynamic phenomena and riser-flow phenomena.

The effects of transients that could be expected to occur during operation were also measured. Induced transients included turbine-generator trip-out, complete reactor isolation and scram (safety shutdown), intentional pressure disturbances and trip-out of the recirculating pumps. Specific transient tests included these:

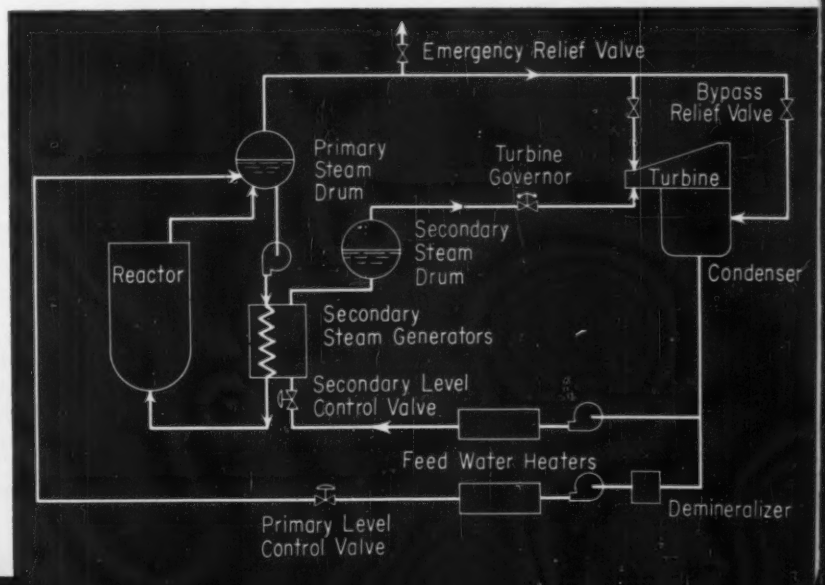
Bypass valve testing. This consisted in manually opening a turbine bypass valve (1 of 8 such valves) and rapidly reclosing it. Resulting disturbances in reactor pressure and neutron flux were only 4 psi and 6%, respectively, neither a significant disturbance to the system. This follows essentially the predicted behavior.

Dual-cycle load rejection. During a 25-Mw load change, the reactor flux followed the transient smoothly and steadied out at a new lower level corresponding to the lower power level. Primary steam flow held essentially constant and primary pressure held constant within 1% over the transient.

Recirculation-pump trip-off tests. At 500 tMw, two of four recirculating pumps were tripped off simultaneously, producing a decrease in reactor power of about 17% and a reduction in total core flow about 25%. Reactor flux fell off sharply immediately following pump trip and then recovered gradually over a period of several seconds. The undershoot in flux was less than anticipated and was smooth and stable.

Turbine trip-out tests. One of the most severe reactor transients during operation is sudden trip-off of the generator or turbine. A generator trip-out was simulated by manually actuating the overspeed trip for the turbine. The results of this test at about 450 tMw initial reactor power showed a pressure rise of 16 psi in ½ sec. The rapid pressure rise produced a sharp neutron-flux rise, which returned to its initial value in about a second. This test was made with relatively high pri-

FIG 1—**DUAL CYCLE PLANT** adds secondary loop to basic boiling-water system to improve load following and increase power from given reactor vessel



mary-steam flow and low secondary-steam flow, which provide greater than rated core voids and void reactivity. These conditions, more severe than normal operation, caused a greater percentage increase in flux than would be obtained at the same power level with normal dual-cycle operation.

Reactor isolation test. This was performed at the rated reactor power by activating a vacuum trip. This trip closed the turbine stop and bypass valves and scrammed the reactor. The initial reactor pressure peak, about 25 psi, was less than expected and was not enough to actuate either the relief valves or the emergency condenser. The results of this test were less severe than anticipated.

During all phases of the power test program, and especially during transient conditions, measurements were made of plant vibration characteristics, which proved to be within limits in all cases, under both transient and steady-state conditions.

	Method of Measurement (described below)	Hot-Spot Factor
Axial	A, B & C	1.60
Radial (includes intercontrol rod)	A	1.30
Local (corner rod)	B	1.39
Transient and maneuvering	Transient tests	1.25
Over-all hot-spot factor	Product of above	3.60

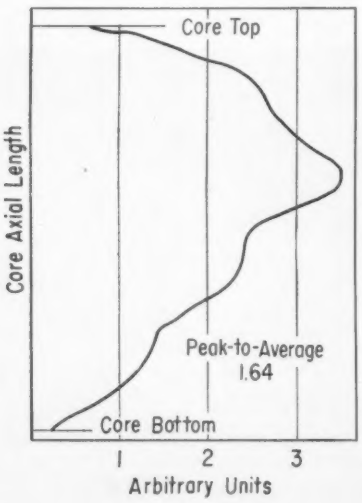
A—Gamma probe. A small gamma-sensitive chamber was mounted on a long, thin probe, which was inserted into 84 selected fuel assemblies in one of the four symmetrical quadrants. The symmetrical control-rod pattern allowed detailed measurements of one quadrant, which was representative of all quadrants. The readings were taken at 2-in. vertical intervals. Fig 2 and 3 show a traverse across the score and an axial power trace in one fuel bundle from gamma-probe data.

B—Gamma scan. One fuel bundle prepared in advance for disassembly after short service was removed after half-power operation. An axial gamma trace on it established the peak-to-average rod power across the bundle.

C—Wire scan. During calibration of in-core monitors, wires of 1% copper and 99% titanium were inserted directly into the reactor in 16 locations to provide both axial and radial power measurements during operation. Results, based on an activity counting method, checked very well with values from the gamma scan and gamma probe measurements.

Because the peak-to-average heat flux in a reactor core is basic to determination of the safe power level that can be achieved, it was of paramount importance to be able to both control and measure the power distribution within the core. There was concern whether the practically achievable peak-to-average heat-flux ratio would limit power or unduly restrict control-rod positions. This concern stemmed from uncertainties about stability, calculations that had not yet been confirmed by quantitative measurements of steady power distribution in the large core, and the then unproved ability to control power distribution with the rods and subcooling. A proved practical system of instantaneously measuring core power to assist in answering these questions did not exist. So a major effort went into developing for Dresden a reliable system, which would likely be needed also for future boiling-water reactors to exploit safely the minimum core size for a given power.

Core power distribution was measured in detail during and following rise to half power. At half power, a ten-day steady-state run was made to fix in the core a measurable gamma fission-product distribution, which is a measure of power distribution. The methods used and the obtained hot-spot factors or ratios of peak to average



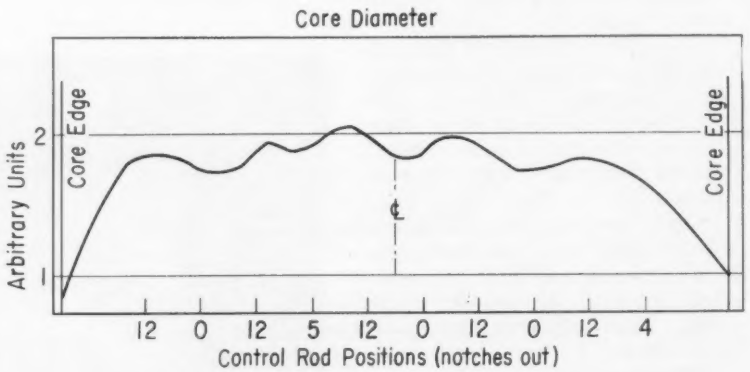


FIG 2 (left) and 3—POWER DISTRIBUTION, axial and transverse, in the core is shown by plots (in arbitrary units) of gamma activity measured with an in-core gamma probe inserted into fuel assemblies after ten days at half power. Effect of control rods on power curve is indicated by settings shown above

power, are tabulated opposite.

The gamma probe was again used to measure core power distributions during the current shutdown. This was an important measurement because it showed that the full-power peaking values obtained were comparable to those tabulated for half power. This confirmed the belief that axial and radial values measured at half power could be held and likely improved at full power. It is further believed that these values can be maintained over the core life. The fact that readings at full power are comparable to those at half power had been indicated on the rise to full power when no in-core monitor reading exceeded 90% of the expected full-power peak flux and this was held at full power. Another reason for optimism is the expectation that the corner-rod peaking factor should be reduced somewhat by burnup with life.

During power generation, in-core monitors provide the means of safely keeping within limits of heat flux and local power generation established in the Dresden operating license. There are 16 assemblies of four chambers each mounted vertically. During initial rise to full power, 57 of the 64 chambers were in service, calibrated and providing information. Now 63 are in use.

Besides measurement of power flattening, ease of reactor control is a key feature of operation. This is perhaps best illustrated by the way full power was first reached. The reactor was operating about 550 tMw with an established rod pattern. Secondary steam flow was increased until two in-core monitors read higher than desired. Adjustments in the control rods were made to decrease the power distribution in local core areas, and secondary steam was increased again. When full power was reached, no in-core monitor reading exceeded 90% of the maximum expected peak heat flux. Fig 2 illustrates this power shaping with rods.

The flexibility of the dual cycle and the bottom-entry control rods provide the operators with a useful means of control. These, combined with the visual and instantaneous indication from the in-core monitor system, allow the operators to maintain an efficient burnup and power distribution. From experience so far, there is optimism that power shaping and flattening at Dresden can be readily accomplished over the life of each core.

The proper load-following performance of the dual cycle was contingent upon proper understanding of the interaction between a number of nuclear parameters that affect reactivity. The reactor follows load without control-rod movement from 55% to 100% of full load. In practice, primary steam flow is established at rated value with the control rods. This value of primary steam represents about 55% of full load. Thus the control-rod pattern and desired core-power distribution are established at well below limiting conditions. Power is then increased to 100% by merely increasing the secondary steam flow to the turbine, and load following is achieved by simply letting the turbine demand more or less secondary steam.

Fig 4 shows the primary-secondary steam flow relationships experimentally determined. Reactor operating experience indicates that the dual-cycle map or control characteristic curves are well maintained over reasonable variations in control-rod patterns.

Radioactivity in the steam and condensate systems of the plant was significantly less than contemplated during design. Carryover of nitrogen-16, which has a half life of 7.35 sec, in the steam is the only sizable contributor to dose rates in these systems. Of 400 curies of N^{16} produced per sec in the reactor core, only 5-8 curies per sec reach the turbine. The turbine is unshielded, and dose rates of 10-60 milliroentgens (mr) per hr are experienced by an operator during an inspection of such items as bearings and front standard controls. Dose rate at the generator collector rings is less than 0.5 mr per hr. These measurements were made at full power.

Probably the most significantly low radiation levels are around the condenser water boxes (3-5 mr per hr) and beneath the hotwell (20 mr per hr). Because a large portion of the N^{16} in the steam is in the form of non-condensable gas, the hot spots—hot from a radiation standpoint—are locally on the condenser, where 200 mr per hr is measured on the off-gas take-off, and in the shielded air-ejector room, where the concentration of N^{16} in the gases is increased and area radiation levels reach 1 r per hr.

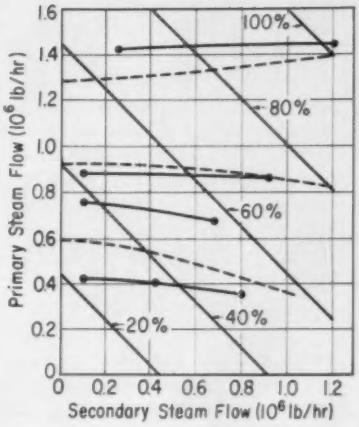


FIG 4—STEAM FLOW changes for load changes were calculated (dashed lines) and checked by experimental load swings (solid lines). Diagonals show percentages of full power

Concrete shielding thickness needed around representative components of the Dresden system are less than originally contemplated. The estimated saving is about 2,600 cu yd of concrete for a similar plant. Because of the short time of operation so far, the activity buildup due to corrosion products is not yet meaningful. Experience with other boiling-water reactors has shown there is little likelihood of significant turbine contamination.

For the large boiling-water reactor, a number of design features, such as full-diameter vessel-head opening and fuel-handling procedures, were unproved until the successful operation of Dresden. Also the magnitudes of problems relating to maintenance and repair of radioactive components were undetermined. A number of routine and special operations carried out during the test program demonstrated the practicality of the full-diameter opening for access to the pressure vessel and such operations as maintenance on the vessel head, visual underwater handling of fuel and simple maintenance of reactor components.

Formerly, the stability limit imposed by voids and the heat-transfer limit were the more controlling core design limits. Test results and extensive analytical studies have

shown that, with positive flow obtained by forced convection, the stability limit of voids is much beyond the value previously assumed and, indeed, may be high enough so it is no longer a serious economic limit. For a given limit in core voids, power densities can be increased either through increased pumping or increased subcooling. The choice is an economic one and is largely determined by the allowable limit on steam void fraction.

For large plants, the forced-circulation cycle can make significant economic gains through the compactness resulting from higher power density. Greater permissible voids increase the feasible plant size for both the forced-circulation single and dual-cycle plants. The pumping required for a given power is reduced and the upper limit of internal steam separation is raised. Thus, whether the choice is single or dual cycle, raising the void limit is an economic asset and can make very large plants practical while still using internal steam separation.

Dresden experience has also shown that the burnout margin, the minimum ratio of burnout heat flux to actual flux, may be decreased. The burnout margin is dependent upon the operating conditions that prevail at the highest power region and not just the average conditions. Because the control, hence also measurement, of power distribution within the core is of paramount importance, a design burnout of 2.0 was chosen for Dresden. Experience with in-core monitors for measuring power distribution and the ease of control with rods now make a burnout margin of 1.5 safe. This, along with raising the allowable void limit, significantly raises the allowable power output from a given core. Proved core stability, proved feasibility for flux shaping with rods and performance of in-core monitors make the original design conservative.

The significance of the new limits can best be seen through quantitative comparisons. For a fixed flow rate of 40 million lb per hr and subcooling of 16.4 Btu per lb, the power of a 360-tMw single-cycle reactor can be increased to 935 tMw by raising only the allowable core void limit from 10% to 25%. By increasing the void limit from 10% to 25% at Dresden, power from its dual-cycle reactor could be increased to 900 tMw from present design of 626 tMw without changes in the pumping plant.

The burnout limit is of equal importance. The very high power outputs discussed above in conjunction with high voids would require a very large core heat-transfer area when using the original Dresden burnout limit. In fact, power densities could be so low as to make vessel size uneconomical, or, alternatively, if power density were improved through small fuel rods, it could make fuel cost excessive. The new burnout limit of 1.5 instead of 2.0 reduces required fuel heat-transfer area 33%, and the new burnout heat-flux data from recent tests make possible another 20% reduction. Even for the single-cycle case of 935 tMw with 25% voids, the power density is 37.4 kw per liter (or w per cc) with a kva-transfer area of 30,300 sq ft. The required vessel size is only 162 in. inside diameter, and the rod size is in the economic range. Thus, the combined improvements of increasing voids and reducing burnout margin have greatly increased achievable power from both single and dual cycles for a given pumping plant.

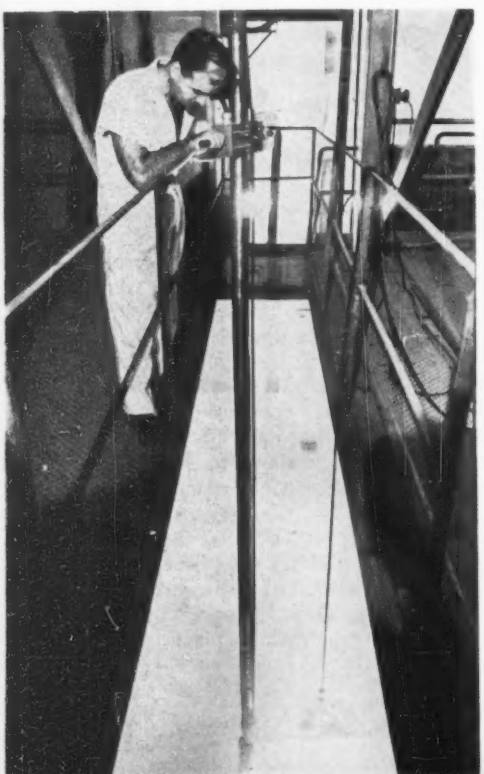
While comprehensive plant designs are needed to demonstrate specific cost savings, a discussion of design concepts for the various types of boiling-water plants indicates the most likely directions for future plants.

The natural-circulation reactor, characterized by its extreme simplicity, will probably continue as the best reactor for small sizes. The upper limit at which this type has economic advantages cannot be accurately fixed now, but plant size is likely at least 100 Mw. Hydraulic void stability, rather than nuclear, is the present limit, though further gains through non-nuclear loop experiments may be realized. Another advantage is that there is no problem of radioactivity buildup with time as the "primary loop" is the downcomer inside the vessel. Except for a cleanup loop, all the external piping and components enjoy the benefits of a separation factor greater than 10,000 for carryover of radioactive corrosion products. The real worth of this factor is not yet established.

The main advantage of the single-cycle plant is compactness, with its potential for lower cost. A large portion of the cost of a nuclear plant is associated with components outside the reactor proper. One such factor is cost of piping and buildings, especially the reactor enclosure. The feasibility of pressure suppression is directly associated with compactness of the primary loop, as the dry well must be be designed for a relatively high pressure. Internal steam separation and closely arranged pumping loops make this approach both feasible and economically attractive. Plant output of 300 Mw is now practical for this type plant.

Raising the allowable limits of voids and heat transfer burnout make the dual-cycle plant feasible to at least 400 Mw. Internal steam separation for this size plant is essentially proved today. In very large sizes, internal steam separation, together with a relatively small main pressure vessel, makes the dual cycle particularly attractive. Additional known cost improvements include reduced shielding and higher power density. Future plants would likely have an average core power density of 35-55 kw per liter.

UNDERWATER GRAPPLE, crane-lifted and visually guided, moves fuel elements into and out of reactor core



REVIEW OF 1960

1961 PREVIEW

The ledgers of 1960, the first year of the "Soaring Sixties," are being closed.

For the electric utility business, what kind of a year has it been? Will the power historian of the future, poring through these ledgers, acclaim 1960 as a year of significant impact? But more of interest to us today . . .

What do the events of 1960 presage for the coming year?

In the pages that follow, the editors of Electrical World have attempted to supply answers to these questions. They've tried to assay 1960's events, and to evaluate consequent effects on 1961.

In this interpretation, most of the nine editors who worked out these pages were hard put to keep "editorializing" out of the copy. It wasn't easy, because in almost every sector even objective people grow strong ideas on how the industry can make improvements. And some of these improvements seem to fairly cry out for action. The Editorial Comment (p 43) ticks off what the editors believe to be the most pressing of these needed improvements; EW's Editorial Comment throughout 1961 will continue to hammer at them in more detail and as events unfold.

Well, what kind of a year HAS it been for the electrical utility business?

From the standpoint of electric utility total energy sales, 1960 was short of target, up about 6% over 1959 instead of the 8.8% that we were expecting this time last year. Even though the US economy as a whole moved uncertainly over

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the entire year, power sales continued their inexorable rise, with only the industrial component materially affected. Trying to read the near future of the economy as a whole, and its effect on power, is made hugely difficult by uncertainties posed by the yet-unstated policies of the incoming Administration. Thus this analysis will leave 1961's power sales and utility capital expenditures prognostications to *Electrical World's* statistical reports, due Jan. 23 and Feb. 27.

But it can be said that our predictions for the decade of the Sixties, made this time last year, are not shaken because of the uncertain economic pace in the first year of the ten. Our figures were based on good solid ground. If we gave the impression that *all* years of the Sixties would be as rosy as the full decade . . . why, we're in good company.

In the technical areas of engineering, construction and operation, 1960 saw marked changes in several of the segments of utility endeavor. In distribution, as usual, there were few dramatic advances, or clearly evident work toward dramatic advances. This is hardly surprising; it seems to be the nature of the beast.

But in bulk system planning, in generation (conventional and nuclear), and in transmission, the long push by manufacturers and utilities on R&D continued to pay off—*and to create the need for further R&D.* Four of the following articles are devoted to what happened and why—and what this means for next year—in bulk systems, generation, and transmission. And a fifth piece assays the problems and the slow but steady gains in distribution technology.

Incidentally, behind many of the engineering advances of this year lurks the winking, chattering presence of the high-speed computer, that obedient "moron" which power engineers are swiftly managing to teach the business. Firmly entrenched in bulk system planning and apparatus design, the computer now has a foothold in operations and another in the design and construction of facilities. And it is growing to be the white hope of distribution system planning.

Any trends in utility engineering, this or any year, are brought back (or should be) to economics as the base motivation. But sometimes the deeps of economic analysis are not plumbed as thoroughly as they might be. The advent of the computer is removing the last *technical* reasons why this cannot be done. The long-festering conflict between the investor-owned utilities and their public power counterparts seems right now to be supplying what further motivation might be needed, especially in the field of bulk system planning (see p 57).

But political events themselves are destined to affect this controversy, over the long term. As noted above, it's too early to assay with any accuracy what the new year will bring here. But we've tried to set the stage, as we see it, for what you will witness next year in the political arena (see p 64).

One of the big events of the past year, of course, was the trip to the bar of justice of the electrical equipment manufacturers. The grand jury antitrust investigation; the coincident unleashing of the full force of competition on prices, which allowed production overcapacity and the threat of foreign competition to depress the general price level; these have been well described in the public and business press, and there's little need to review here the sequence of events. But questions—big questions—are yet unanswered. And, starting on page 65, we've set some of them forth.

Our articles at this year-end do not include such familiar subjects as load patterns, financing, rates, regulation, public relations, and personnel. Does this mean *Electrical World* believes these subjects no longer vital?

Absolutely not! But, in our opinion, very little of moving significance occurred in these areas this past year. And, perhaps sometimes unfortunately, very little *will* happen of import here in 1961.

The investor-owned segment of the utility industry, we should note, is paying more and more attention to what the public at large thinks of it, not only on "Main Street," but as a national institution as well. On the national level, thinking and efforts are far from bold and incisive, but they are there.

What things DID happen in 1960, and WILL happen in 1961? Here is what Electrical World's editors think.

Studies Push Tighter System Integration

Editorial Comment

No Sovereignty Loss in System 'Mergers'

The past year witnessed unusual activity in the area of power system planning studies, all with the view of strengthening existing pools and interconnections and/or providing new heavy ties. There is no question but that this flurry of investigation will continue across 1961, and that actual construction work to implement the studies will be underway.

The study work now in progress seems well divided between investor-owned utility groups on the one hand and public power groups on the other. As usual, the former are working under wraps and the latter are pushing the publicity button.

The upsurge in activity in both camps, though based on economic considerations, can be traced to political motives. The triggers aren't hard to find: the Kerr (Sen Res 48) Committee report requirements; the imminent availability of new federal power in the Upper Colorado Basin and of New York State power from the Niagara; the pressing need to consider how vast amounts of western Canadian energy will fit into the US Pacific Northwest and perhaps beyond; the eagerness of public power adherents to capitalize on the change in Administration; and the growing recognition of investor-owned utilities that their best defense against the latter is a good offense.

With some exceptions, the studies, however motivated, are searching for economies in larger unit sizes, lower reserve requirements, and lower production costs. And they are finding frequently that potential economies are much larger than they expected. In part this may be due to the upward march of temperature sensitivity coefficients, which provide ever-larger north-to-south diversities. But in the main it can be laid to previously-unexplored potentials of more complete integration within and among already existing pools.

Actually the need for extending already-held experience in integrated operation of power systems to integrated planning and engineering has long been recognized by leaders of the industry. Integrated planning, as exemplified by the New York State ESUPRA group last spring, is bound to do much to promote new interconnections. It should be noted that studies to the depth now undertaken haven't been practicable until fairly recently. The availability of large computers, together with highly advanced study techniques, has made possible comprehensive analysis of future power systems. The economics of different sizes and types of units and interconnections, requiring a comparison of capital and production costs over a long period of years, can now be analyzed more easily. New opportunities for economies in interconnecting can be discovered and evaluated.

The country is destined to see a speeding-up of the trend toward the formation of large pools where every advantage is taken to minimize costs through fuel economies, maintenance scheduling, and emergency assistance. The extensive experiments in transmission lines, studying all aspects of extra high voltage, will result in more economical line design, thus justifying interconnections not previously economic.

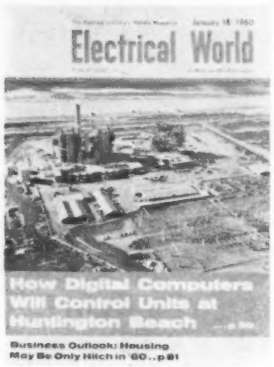
Actually, the past year has seen announcements and discussions of several major interconnections. The 345-kv Niagara Falls to New York City interconnection, substantially increasing present ties, was announced early in the year for completion in 1962. The Bonneville to California interconnection, and the Upper Colorado transmission system, extensively discussed in the past year, will be studied, and may be resolved, in the coming year.

Inter-pool connection of the Pa.-N.J.-Md. with the Canadian-US Eastern interconnections is a distinct possibility. The major part of the 2-million kw Niagara Project

will go into service with its power rippling throughout a wide geographical area. This, together with huge units under consideration, provides an incentive to tie these two large interconnections together. In addition, major EHV interconnections may be announced in the Midwest. Consideration of kilowatt turnpikes to carry coal-field energy to high fuel cost areas is another strong interconnection stimulant.

While the past year has seen emphasis on faster breakers and relaying, next year will see even more efforts on the use of complex and fast relaying schemes to minimize the required number of breakers. These, in turn, require communication systems which in many cases will be microwave. The installations of microwave systems with their expandable capacity will lead towards centralized data-collection and logging. This, together with existing computer control of systems, will see the use of computers to perform system functions in much the same way as computers are being used in power plants. At the same time, computer control of systems should spread to control of pools, as well.

Computers Pace Generation Progress


Electrical World
How Digital Computers Will Control Units at Huntington Beach
Business Outlook: Housing May Be Only Hitch in '60...p 81

Both 1960 and 1961 can be checked off as landmark years in the constant evolution of generation facilities. Projects planned in these two years, as well as projects scheduled to be placed on the line during this period, will be watched closely for trends they may set in generation.

The application of the digital computer to generating plant control is having a currently substantial effect on generation design philosophy. Eight computer-controlled plants are now on order, and the first of them is expected to go into operation early next year. Operating data obtained from these early installations should determine whether the trend toward computer control accelerates rapidly.

Computer advocates contend that increasing generator sizes place a premium on the prevention of operating errors and other service interruptions leading to loss of capacity, because the cost of each outage has rapidly reached alarming levels. The development of computer programs to maximize economies will be tied to programming to spot incipient troubles and to take steps to minimize damage to the unit and the system.

At any rate, new methods of obtaining and handling data from steam plant production will certainly color over-all station designs almost immediately. Data logging and heat rate performance computers, well entrenched enough to be installed in at least 20% of the stations scheduled for construction during the next four years, will enable designers to evaluate continuously the performance of many components for the first time.

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The past year provided clarification of the peaking capacity situation, and the coming one should improve the picture even more. Data released on existing diesel peaking units indicate that reliability and cost have equalled or surpassed expectations, thus brightening the future of this method. Plans were announced for construction of significant amounts of pumped storage capacity, and gas turbines were also ordered. Some operating data may be forthcoming in 1961, and the place of each peaking method in system planning should become clearer.

Recent announcements of "turnkey" plants, where single manufacturers have assumed prime contractor responsibility, are causing considerable speculation. Twelve months from now it should be easier to see how this philosophy will fare.

The past year saw boiler designers back away from 1,100F steam conditions. No new supercritical units were announced, although three such units went on line in 1960. This situation, caused by metallurgical cost and operating life problems, should continue through 1961 with no breakthrough in the offing at this time. The lid seems to be clamped on at 1,050F, although smaller units will be using this temperature than was customary in the past.

Faced with this technological barrier, designers will continue to experiment with combination cycles. Combined gas turbine-steam generator units are appearing—Oklahoma Gas & Electric Co ordered one last June—and the supercharged boiler may be just around the corner. Of course, sizes of units show no signs of slowing their growth rate. A contract award is expected on an 800-Mw unit, and designers claim that a 2,000-Mw unit can be built.

Newer electrical auxiliary systems are rapidly coming on line, and operating experience will again determine the spread of their acceptance. The first auxiliary system above 4,160 v (6,900 v) is on the drawing board, although it is not scheduled for operation until 1962. It will accompany a 650-Mw unit.

Elsewhere in the auxiliary equipment field, boiler feed pumps driven by turbines or off the main shaft are piling up experience records which will influence future designs. Separate BFP turbines for units as small as 200 Mw are being installed, and the coming year should see even smaller units using this method. The number of standby pumps is dwindling, and they are certain to become even scarcer in the light of modern pump performance. Turbine-driven fans and other auxiliaries are also expected to make an appearance.

In generation, manufacturers and utilities will conduct a vast amount of research and development in the coming year. Exotic power sources, as well as conventional generation methods, will be pushed hard. The direct conversion of heat and chemical energy into electric energy by means of thermionic, thermoelectric, and magnetohydrodynamic devices and fuel cells, being studied by many companies, will result in more experimental devices in the next year. A sharp increase in MHD research already has been announced by several major manufacturers. The fuel cell, a device with potential to change the character of the entire electric utility industry, is being investigated by a score of companies for military, transportation, utility or residential use.

New emphasis on air pollution hazards can be expected in the year ahead. The US Public Health Service may make recommendations based on its current research effort, and industry groups are studying the problem as well. Regardless of the amount of pollution actually contributed by steam stations, they can suffer from regulatory moves if severe temperature inversion or other smog-producing weather occurs. At best, the situation will remain sensitive, with utilities regarded suspiciously by local authorities.

Nuclear Construction Quiet, May Pick Up

The big Dresden and Yankee plants came on the line in 1960 with 316 Mw and not many more bugs than most fossil-fuel power plants have to iron out. Elk River, Indian Point, Piqua, Hallam, EBR-2 and Enrico Fermi, representing five different basic concepts, should add another 365 Mw of completed plants next year. But the total completions now in view for 1963 and later is only five plants, all but one of them rated at 50 Mw or less, and currently there is little activity for the designers. It may pick up, however, for a handful of major utilities that have participated in joint projects have been talking about erecting their own nuclear plants.

Thus nuclear power seems to be following the classic pattern for new developments: pioneering, watchful waiting, commercial production. We are now in the period of watchful waiting, as evidenced by only two 1960 announcements of new plants by utility systems: by Southern California Edison Co and Los Angeles-Pasadena municipalities. How long this period will continue and how it will affect the nuclear manufacturing industry are yet to be seen. Presently, the outlook has light and shadows.

Research and development continues progress with a kaleidoscope of experimental reactors, study programs, test facilities and basic research. The double-barreled program recently announced by seven New York utilities, conjoined for this effort as the ESADA group, is a welcome $17-million addition. Thirty-odd zero and low-power AEC reactors that fall into the R&D class continue to form a foundation for nuclear power. Recent approval of the pressure suppression system in lieu of a containment sphere for Humboldt Bay improves the outlook on initial investment, which remains far the largest component of nuclear energy cost. Steady advance—chipping away of the barriers rather than breakthroughs—should continue to make noticeable cost reductions. Even now, with the designers all looking for work, they stand ready to outbid each other and make a nuclear plant economically attractive, if not yet absolutely competitive.

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The designers are, of course, doing some business, but it is foreign contracts and federal projects that have been keeping them going. With the three-year or more lead time for design and construction, it looks like there will be a valley of few completions in 1963 and 1964, perhaps into 1965. This is likely to slow the development of a nuclear plant components industry, particularly for fuel refabrication.

The only facilities now for fuel refabrication are AEC-owned. Two industrial concerns are looking into the prospects of entering the field, although Yankee Atomic Electric and Consolidated Edison have withdrawn support from one of them. That there are now 23 generating plants built or on the way would seem encouraging. But their wide variety of fuels, cladding and fuel-element configurations has militated against setting up a production-line refabrication facility.

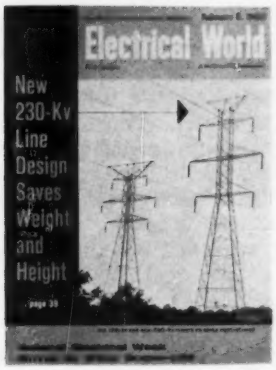
On the owner-operator side of the picture, with three commercial-size nuclear plants now on the line and others well along, knowledge of nuclear plants is increasing among utility men, many of whom have trained on projects going up on other companies' systems. The relative ease with which Dresden and Yankee went into operation is highly encouraging. The utilities have demonstrated that nuclear plants are not unreasonably demanding on personnel selection and training. They can be operated as easily as fossil-fuel plants—probably more easily—and will run with stability clear down to zero output.

An aspect of further encouragement—if of some current frustration—is the potential of outputs much higher than those designed for. Dresden, Vallecitos, and Shippingport have indicated reactor capabilities far above what their turbines can take. The builder expects another 80 Mw out of the SENN plant, being built now in Italy for 150 Mw. In step with this aspect is the increase of plant sizes. The French-Belgian SENA plant will produce 242 Mw and that for Southern California Edison Co, 360 Mw. Prospects are in view for still bigger units.

Next year should also produce some governmental activities aside from the civilian power reactor program. The Supreme Court is expected to rule on the Enrico Fermi case. A potential giant plant looms in the form of the AEC's New Production Reactor, now building at Hanford, Wash. Somewhat farther in the offing is TVA operation of the Oak Ridge 22-Mw Experimental Gas-Cooled Reactor, due to go critical in late 1962. The Power Authority of the State of New York, now limited to hydro development, has indicated it may seek to have its franchise broadened to include atomic power.

The problem of allaying public apprehension of radiation continues. It calls for the joint effort of federal, state and local health services, medical associations, and an informed press as well as the nuclear manufacturing industry and the utility companies.

Research Is the Word for Transmission Today



1960's explosion in extra-high-voltage research and development is at once the hallmark of transmission today and the foreshadow of its expanding future in a period when the economics of energy transport is swinging from wheels to wires. The year 1961 will feel its first effects on actual construction.

This year's burgeoning efforts and expenditures for R&D clearly reflect widening industry recognition that transmission is destined to play a vastly bigger role tomorrow than it does today. Not only will it be called upon to an extent heretofore unimagined to provide the sinews of the rapidly strengthening pools and interconnections; it must continue to conserve expensive rights-of-way now crowded with low-voltage circuits of limited capacity.

During the past year no less than four major EHV research projects and test stations were placed in operation: at 460 kv on the system of Pennsylvania Electric Co; at 460 to 750 kv at Pittsfield, Mass., Project EHV; at 345 kv at the Cornell University EHV Cable Test Station, sponsored by AEIC and EEI; and on the 460-kv project at Trafford, Pa.

Last year saw the startup of the 460-kv Coldwater Project in Canada. In 1961 a new 750-kv project will be started up at Applegrove, W. Va., on the American Electric Power System. All these projects, intent on reducing transmission costs, extend and expand early EHV investigations begun at the Tidd Project in the Fifties and others now nearing completion at Leadville, Colo.

In 1961 the newer and more sophisticated EHV research facilities will settle down to the serious business of producing new and detailed data on corona and RI at various altitudes and under different climatic and contamination conditions. In each project, prototype lines of various configurations are measuring the performance of apparatus, single and multiple conductor arrangements, tower types, insulator and hardware assemblies under lightning surges, vibration and icing conditions.

Next year will also bring an extension and expansion of the revolution in structure design that is already making possible marked reductions in the weight and cost of both EHV and lower-voltage structures. The year will see completion of short experimental lines at Tennessee Valley Authority, Illinois Power Co and Bonneville Power Administration to try out structure design and construction practices on developmental EHV towers of wood and steel. On these lines, as well as at Penelec and Project EHV in Pittsfield, experimental structures will be employed that use prestressed concrete, laminated wood, tubular steel, extruded and tubular aluminum shapes as well as various high-strength low-alloy steels. The first functioning lines using some of these revolutionary materials will be built next year.

Traditional tower configurations will begin to change silhouette in 1961, as designers seek to capitalize on special properties of each new material and achieve cost savings. Among the new tower contours is a guyed aluminum tower with lattice columns arranged in vee to rest on a single footing. Other guyed designs use tubular steel or aluminum in portal or H structures, some point-supported on minimum footing to hold down foundation costs.

New designs using aluminum and high-strength, low-alloy will be put to work on pioneer lines and substations where the corrosive environment eats into the life of galvanized coatings. Next year, too, helicopters will be used more widely

to speed tower erection and conductor stringing and so make further inroads on cost.

In 1961 two significant changes in the fifth edition of the National Electrical Safety Code, approved in 1960 as an American Standard, will be put to use on many new tower lines. These changes permit a reduction in conductor-to-ground clearance approaching 10% on 345 kv and cut permissible swing angles of suspension strings from 45 to 30 deg on grounded structures. Taken together, these code changes will reduce tower heights, shorten crossarms lengths and affect the number of towers per mile of line. These economies alone hold out reductions in the cost of towers, particularly in the EHV range. But, taken in combination with new tower configurations and materials, they promise startling savings in structure cost per mile and will broaden the economic scope of EHV lines in the years immediately ahead.

1960/1961

As the industry enters the new era of transmission, choice of voltage steps above 345 kv remains unresolved as between 460 and 500 kv. Beyond these values, consideration, both here and abroad, is being given to 690 and 750 kv as a basis for international standardization. One big impediment in this, however, is the difference that prevails between nominal and maximum voltage in the US and elsewhere. In the US it is 5%; elsewhere 10%. Meanwhile during 1961 research will move forward at 460 kv, and higher, without any clear decision as to which voltage is best for the industry and for EHV.

It remains a moot question today whether the growing knowledge of EHV technology and its role in power system interconnection is fostering use of 300 to 500-Mw turbine-generator units, or visa versa. In either event, the industry appears to recognize the savings offered by pooling of generation and to be embarked on developing EHV interconnections to an extent that may yet see the transmission of large blocks of power across the breadth of the country by displacement. But first the new knowledge coming out of the new EHV research projects in 1961 must be hammered into a new pattern of high-voltage design and operating practice.

Distribution Sets Gains, Finds New Problems

Electrical World
First 240/480 V Buried
System for All Electric Homes
Will Be Competitive ...page 42
A NEW LOOK AT COST OF CAPITAL

Considerable confusion today clouds application of 1960's changes in distribution transformers. Actually there were two basic changes. The first was a sharp cut in coil losses which gave a few manufacturers' otherwise conventional transformers more cyclic overload capability within accepted temperature limitations. The new coils also gave enough better voltage regulation to make the added capability useful in serving customers with voltage within acceptable limits.

The second change came as a by-product of research on transformer insulation or re-evaluation of its heat dissipation. This spurred most manufacturers to endorse up to 20% additional loading. Without a compensating improvement in voltage regulation, however, this added capability could not be utilized in every case.

Thus the distribution engineer finds himself able to buy and apply either of two types of distribution transformers. He must now re-study his transformer-secondary combinations to pick the transformer type which offers the best overall economy for his system's combination of load characteristics, growth, voltage limitations, and loss evaluation. Any new program must permit continued use

of existing transformers during their remaining useful life while it capitalizes on the inherent advantages of whichever new type it designates for future installations.

The situation is further complicated by the fact that failure to standardize on the smallest acceptable number of transformer designs leads directly to higher manufacturing costs which could wipe out any potential advantages. Thus the final designation of transformer characteristics should be on an industry basis. But the spread in methods for evaluating characteristics, particularly in values placed on core and copper losses, will have to be cut drastically before industry agreement can be attained. The new year may see progress here.

Service reliability remains as great a goal as ever for distribution engineers. Important advances have come with the sweeping adoption of lashed or spaced aerial cable for circuits exposed to trees. And one East Coast utility found last summer that aerial cable in its heavily-treed areas came through hurricane Donna's blasts with a per-mile trouble rate under a fifth that of open-wire circuits in less exposed areas. A diligent attack on costs had, in their case, knocked down 4-kv and secondary aerial-cable construction to almost the open-wire level. The new construction has been adopted as standard and will be applied extensively next year and the years to follow. And the same engineers are today extending this attack to 13-kv designs.

Such effort can be spurred only by adequate knowledge of the need and of the probable performance of all possible methods and components which are combined in a distribution system. Fortunately this East Coast utility had extensive data at its disposal. Other utilities, today, either have similar information or have set up procedures which will start to turn it out. Thus a growing number of distribution engineers will soon have the facts, some even in 1961, and, with numerous installations of aerial cable and other components under test today, the industry should be able to mount a powerful drive against service interruptions.

In the underground field, too, distribution is poised for a sensational drive. Only a few scattered utilities were ready, three years ago, to offer underground distribution in new residential developments upon payment of a tolerable differential cost and assistance in trenching in cable. Today, thousands of homes are receiving underground service on such terms and dozens of utilities are negotiating with contractors for new installations in 1961.

Key to current proposals is usually the pad-mounted transformer, often in combination with direct-buried cable. The combination, though relatively new, seems to be turning in acceptable performance. And distribution engineers today are seeking improvements to enhance this performance while cutting the cost differential over open-wire systems. In two experimental areas they are even using 480-v distribution to increase the reach of pad-mounted transformers, providing an autotransformer in each home to serve conventional 120-v lighting and small appliances.

Distribution research, working for the most part with existing components, lacks the glamor so expected in research programs. Aluminum alloy, Fiberglas, and alloy steel components for distribution structures are being developed and tested at several locations. These are mainly directed towards more corrosion-resistant components, lower costs, and better-looking structures. New insulating materials are being considered for aerial cables and direct-burial cables. A low-frequency carrier system whose primary objective is air raid warning, may lead to a signalling system for control of switches, water heaters, and street lights as well as broadcast emergency warnings. Computer billing, now used by many com-

panies, will increase the urge for automatic meter reading so that serious research efforts may be made towards this goal in the coming year.

Economic analysis has long been a tool for distribution engineers. But recent advances in the art call for a sweeping review of lore accumulated during several decades. Today, with new digital computers of the required "mental" capacity, this review can be whipped out without the tedious human iteration which produced the old data. Thus computers will become a powerful tool for designers of tomorrow's distribution.

Economic analyses will extend also to construction methods and mechanization, where expenditures on equipment may pay off in lower system costs. They will encompass crew organization, seeking the size and balance which makes for optimum productivity. And they will evaluate the incremental cost of longer-life components against the recurring cost of cyclic replacement. These, and many similar fronts, will be the scene of next year's skirmishes for distribution engineers in their relentless campaign against rising costs.

Kennedy—No Furious 100 Days

Electrical World

Editorial Comment

Power Strategy: A Post-Election View

The young US President who rides up Pennsylvania Avenue Jan. 20 waving a top hat will find much unfinished business awaiting him once he arrives at his oval office in the White House. Among the study papers, proposals, and communications from Congress awaiting consideration by Pres John F. Kennedy will be several dealing with various aspects of electric power.

His rather deliberate movements in choosing a cabinet and initiating pre-term projects gives every indication that he has abandoned his campaign goal of a fast-starting and fast-moving administration. Few observers expect to see a "furious 100 days" such as marked the beginning of the Franklin D. Roosevelt Administration. During that period, electric power men will remember, the late President Roosevelt signed into law the bill authorizing the creation of the Tennessee Valley Authority and, in his relief bills, laid down the basis for the Rural Electrification Administration.

It is reasonable to assume that President Kennedy will be forced to move more slowly. First, he comes into the Presidency with a bare plurality of popular votes. Second, his Democratic party gave up seats in the House and Senate in the November election—22 seats in the House, two in the Senate. And third, there is no domestic economic crisis such as faced Roosevelt in 1933.

Within the first six months of the new Kennedy Administration, we may anticipate consideration of a number of electric power matters. Here are some of the more important:

- The proposed treaty with Canada which would make available some 1.7 million kw of additional prime power to projects in the Pacific Northwest
- Some revamp of Federal Power Commission and Securities and Exchange Commission procedure which would enable those agencies to act with more dispatch and more effectiveness
- The wide-ranging proposals of the Natural Resources Committee of the Democratic Advisory Council
- The new inventory of potential power resources compiled by Sen Robert Kerr's Senate Committee on Natural Resources.

There will be a number of relatively less important questions facing the new administration: How hard should the Burns Creek project be pushed? What should be the official attitude toward the 2% bonds now available for purchase by rural electric cooperatives? Will the Eisenhower partnership power policy statement be withdrawn, or simply ignored?

President Kennedy will be able temporarily to shift some of these matters to the shoulders of his new Interior Secretary, Stewart L. Udall, or to his Rural Electrification Administrator or Federal Power Commission chairman. But actions, as they evolve, remain the responsibility of the new President.

It is possible that the US-Canadian treaty, setting forth the broad outline of joint Columbia River power development, will already be before the Senate for ratification when the new Administration takes over. Terms of the agreement were worked out during the summer and are believed to have widespread support in both countries. Prospects at the year end were that the treaty would win prompt Senate approval.

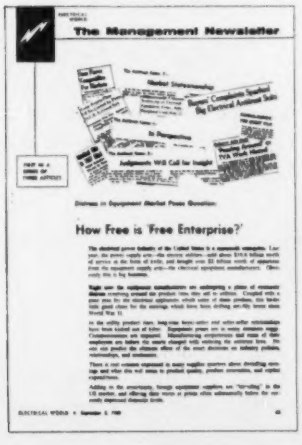
In the area of regulatory commission procedure, Kennedy will carry working papers in his own brief case as he enters his oval office. His old friend, James M. Landis, furnished him with some very specific recommendations for streamlining regulatory procedure and Kennedy is likely to accept some of the recommendations. His job will be to sell these recommendations to his appointees on the commissions and later seek legislative approval for putting the suggestions into effect. Congress created most of these agencies on a semi-autonomous basis and is not like to make changes without thorough consideration.

The real test of Kennedy future power policies will come when he chooses to take an Administration stand on the recommendations carried in the report of the Natural Resources Committee of the Democratic Advisory Council. Supposedly this report served as his "position paper" on power matters during the campaign. But the young President is not likely to overlook the startling political fact that he lost nine of the 11 Western states where reclamation and power development were supposed to have greatest appeal. It would seem likely that Secretary Udall and the new President may want to study the report at greater length and perhaps make some rather drastic changes before they offer it as Administration policy.

The Kerr report on natural resources will go first to the Interior Department and other power agencies for extended consideration before it arrives back on the new President's desk.

If Kennedy is to sustain his campaign image of a man capable of making decisions and capable of action, he will have to move on some of these power issues before the year is out. While some of his cabinet selections are admittedly strong personalities, this quality is not ascribed to his choice for the Interior Secretary. Udall still has to prove his strength. A number of Civil Service holdovers from Truman days will probably have a strong say in Interior Department matters during the formative period of the new Administration and whether present outsiders such as former Interior Secretary Oscar Chapman, former Assistant Interior Secretary Girard Davidson, and former Tennessee Valley Authority Chairman Gordon Clapp will dominate the power policy of the new Administration is a big question mark for the year ahead. It is perhaps pertinent to note that their proposed policies were never fully implemented when they held administrative positions in the previous Democratic Administration.

Suppliers Enter '61 With Uncertainties


The Management Newsletter

How Free is 'Free Enterprise?'

For electrical manufacturers who supply the utility market, the year 1960 has been eventful and significant. Within the past year the manufacturing industry has seen its pricing policies subjected to broad antitrust attack from the US Justice Department; it has seen an era of fierce price competition recur among its members; and it has seen the small but continuing penetration of its traditional home markets by overseas suppliers.

With these events, the manufacturers enter 1961 on a greater note of uncertainty than ever before. In the first place, some of the problems of the past year are not resolved. It is not known what the extent of damage actions by customers will be in the wake of the antitrust settlements. Nor is there any sign that the fierce price competition is letting up in some product lines. And finally, no panacea for the offshore competition problem is in sight.

Of longer range importance for both manufacturers and utilities is an even more basic question, sparked in part by the events of the past year. That question is

how the medium and small manufacturers will fare during and after the transition to the new competitive era of the Sixties. This question is not unique to the electrical manufacturing industry, but events of the past year do make it especially apropos now.

The series of 20 antitrust indictments against many electrical manufacturers had as its purpose the unleashing of a restrained competitive system. That the system has been unleashed there can be no doubt: the current soft prices in many product lines are proof that prices are responding in a classical fashion to productive overcapacity and to threat of foreign competition.

1960/1961

But there are some medium and small manufacturers who say that only the larger suppliers are in a good economic position to ride out this storm while yet investing in research and development for new products and processes and up-to-date production facilities needed to remain competitive in the future. In addition, it is pointed out that overcapacity and low prices may be a chronic problem, since demand is growing only at a fixed rate. Yet the smaller companies need to grow faster to improve their economic position. This growth, if it is to be meaningful, can come only at the expense of the larger, more established firms.

One question, therefore, for 1961 is—Does this added competitive element mean that the normal pace of consolidations and regroupings within the industry will be intensified?

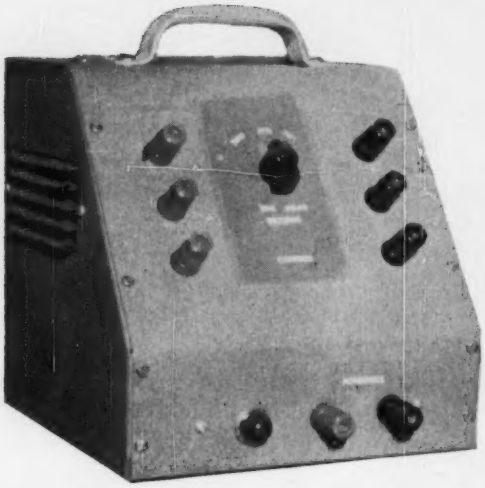
In the matter of foreign competition, the same question may be asked—In cases where there is no clear technological superiority, is the only long-term answer to foreign competition a regrouping into concentrated units, as is happening overseas? Although manufacturers intend to intensify their seeking of protection in 1961, they have so far gained little if any government help. And with the present bipartisan Washington emphasis on freer and expanding world trade, there are few indications that government aid will be forthcoming, although the present gold imbalance is causing a new look at the question. Added to this is the fact that the larger manufacturers are placing more emphasis on their overseas sales and operations, which necessitates a liberal trade attitude at home.

Thus the medium and small-sized manufacturers, with their fewer, or sometimes single product lines, stand to be hit harder by increasing foreign competition. And conversely, with their smaller organizational and economic resources, these companies are not in as good a position to capitalize from export sales and overseas investments. Will these small companies have to consolidate to soften the impact of foreign competition and at the same time be in a better economic position to take advantage of the world markets of the Sixties?

In the US electrical market, there is another factor which may or may not become a trend. That is the matter of "turnkey" contracts for generating stations by equipment manufacturers. Right now there are only three manufacturers in a position to bid on this type contract. If "turnkeys" by manufacturers become a trend, what will be the long-term future for smaller suppliers who build equipment for generating stations? Will the answer be to form consortia (perhaps in company with foreign turbine manufacturers) for the purpose of group bidding, and will mergers and consolidations necessarily result?

Thus the answers to the problems of the competitive Sixties are not clear-cut nor predetermined one way or the other. The answers will come in good part from what suppliers do in 1961. But purchasers, through the act of accepting or rejecting bids, will play a role almost equal in importance.

Season's
Best
Wishes...



Thermal Timer Protects Graphic Instruments

P. R. DUNN, General Serviceman,
E. A. CLAY, Engineering Aide,
Meter Section, Kingsport Utilities, Inc, Kingsport, Tenn.—AEP System

A simple, economical time-delay unit protects costly graphic instruments at Kingsport Utilities, Inc, against high inrush currents during motor starting tests.

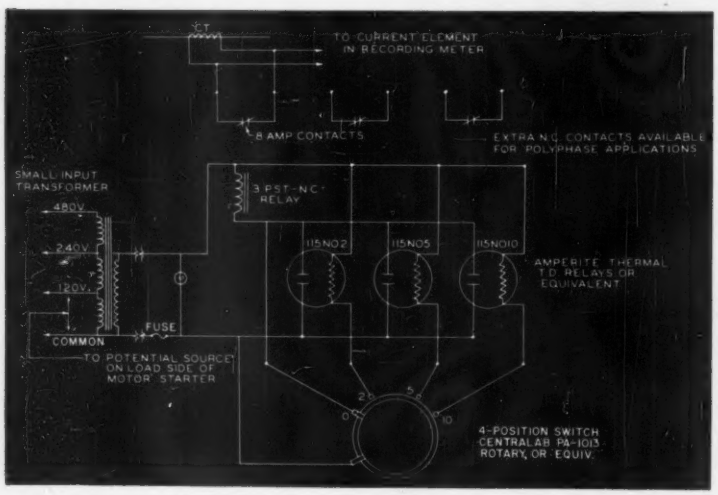
Often it is necessary to conduct a graphic ammeter or wattmeter analysis of an electric motor operation. Motor starting operation creates a problem for these meters.

Motor starting currents cause the meter to slash, and unless a high current-transformer ratio is used, the inking pen goes off scale, bending or breaking the pen and destroying the accuracy of the instrument. A high CT ratio to protect against this damage would result in a normal full-load indication for the ammeter well down on the chart, in the extremely non-linear region. Minor variations would be difficult to read on both the ammeter and wattmeter, thereby defeating the main reason for running the charted test in the first place.

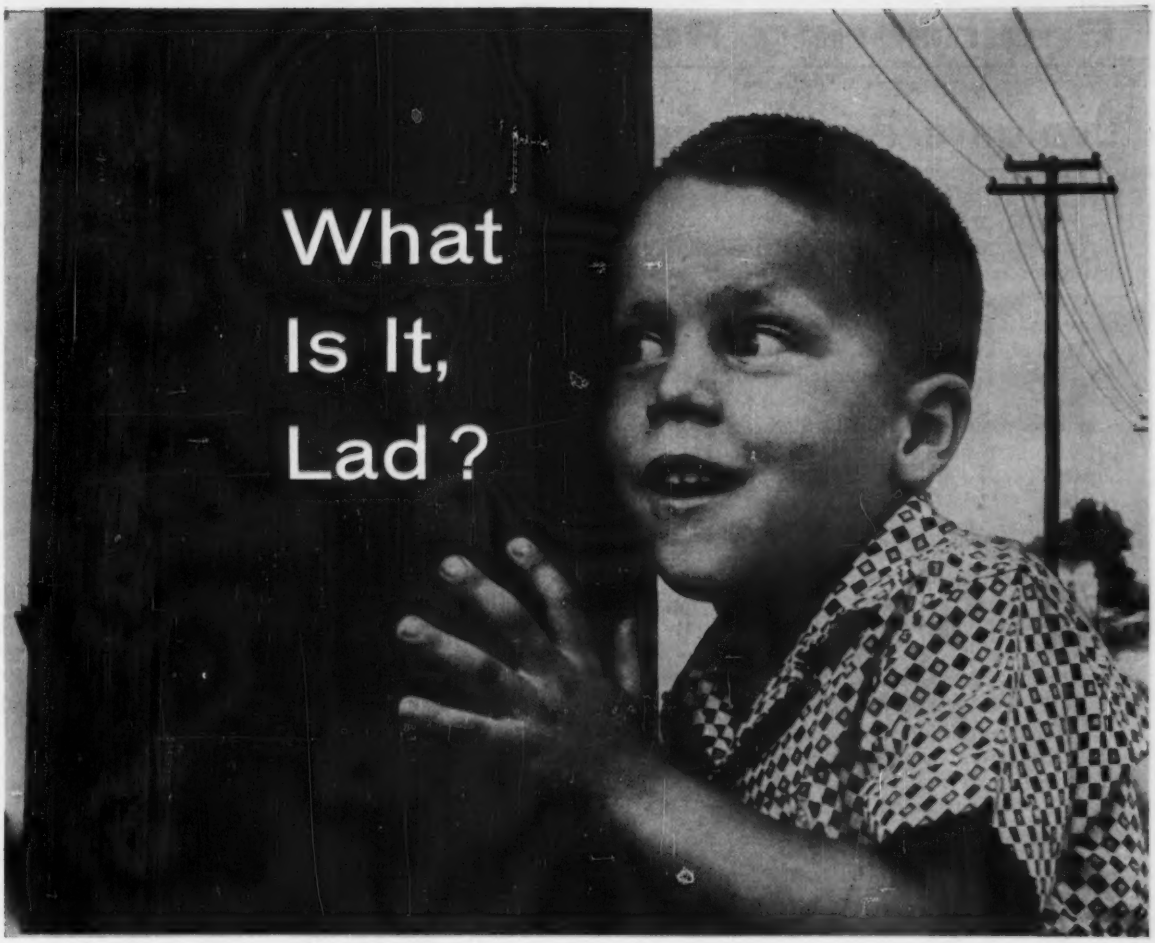
To use the smaller CT ratio and still protect the meter, a thermal time-delay device was built. This device keeps the current transformer secondaries shorted out during a pre-selected starting interval (0, 2, 5, or 10 sec), and thus protects against high inrush current during motor starting. After the starting current subsides, the shorting contacts open to permit the desired load current to flow through the current elements in the graphic meters and thus produce a useful chart.

There is nothing critical about the circuitry. The essential parts are the thermal time-delay relays. These can be purchased from any number of suppliers at a cost of $2 to $3 each, and with a number of heater voltage ratings. Such relays are available with normally-open or normally-closed contacts, and with time intervals from one second to three minutes.

Naturally, the 3-pole relay for shorting the current transformers should have sufficient extra capacity to open these circuits many times. The relay relected for the described application has an 8-amp rating.



The small input transformer of the thermal time-delay device is optional. It can be installed in the instrument or used as an auxiliary unit



Westwinds Blowing Through Southwire

Every inquisitive boy has had his curiosity aroused by the hum of wind through wire. Today throughout the nation—west, north, east and south—when a boy places his ear to a utility pole, chances are he'll hear wind blowing through Southwire. Mile after mile of Southwire spans the nation—in high voltage electrical transmission lines, primary and secondary electrical distribution systems and telephone systems. Southwire began as a regional manufacturer just ten years ago. Today we have customers in 44 states and many foreign countries. Thanks to you and our other customers, Southwire has enjoyed a steady growth. We will strive to continue to merit your confidence in the years ahead.

- Bare and Weatherproof Copper and Aluminum Line Wire
- Neoprene, Polyethylene, and VWP (Vinyl) Weatherproof Copper, Aluminum and Triplex
- U.R.C. (DBWP, TBWP) Copper
- Copperweld® Conductors
- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
- Galvanized Steel Guy Strand and Static Wire
- Aluminized Steel Guy Strand and Static Wire
- Aluminum Alloy Wire
- Cable Accessories
- Telephone Cable
- Machine Tool Wire

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Southwire Company

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SOUTHWIRE serves the world

Evaluate Primary Feeder Losses Quickly

R. W. RYDER,* Stillorgan, County Dublin, Ireland

As loads on primary distribution circuits increase, line losses reduce profits at a far greater rate than is often realized by either engineers or management. These losses can be divided into three main types.

(1) Peak kw demand of line resistance losses. As this increases, generating plant investment is required.

(2) Yearly energy losses due to line resistance. Additional kwhr must be generated to supply this loss.

(3) Loss of revenue due to voltage drop. Some appliances use less kwhr when the supply is below rated voltage.

Consumers Power Co investigated this problem in order to assess the cost of these losses. A simple formula, which can be universally applied, was derived. Field tests were carried out at a new substation which was being provided for increased load. By locating recording meters at several points prior to and after installation of the substation, data was obtained to confirm the results of the theoretical approach.

As the peak kva on distribution lines is usually available by measurement or calculation, a figure for peak demand due to line losses can be obtained readily. For a 3-phase grounded primary line, peak loss is:

$$\text{Peak Loss} = \frac{3I^2R}{1{,}000}$$

$$= 3\left(\frac{\text{kva}}{\sqrt{3}E}\right)^2 \times \frac{rD}{1{,}000}$$

$$= \frac{\text{kva}^2}{E^2} \times \frac{rD}{1{,}000} \qquad (1)$$

where kva = peak kva on line
E = line-to-line kv
r = resistance of wire in ohms per mile or per 1,000 ft
and D = length of line in miles or thousands of feet

Cost of this loss may be calculated by applying representative figures for the cost of new generating plant ($170 per kw) and yearly charges (15%). With these figures, the cost of peak kw demand due to line resistance losses is then:

$$C_1 = \frac{\text{kva}^2}{E^2} \times \frac{rD}{1{,}000} \times 170 \times 0.15$$

$$= 0.0255 \frac{\text{kva}^2}{E^2} \times rD \qquad (2)$$

The amount of energy absorbed by line resistance losses in any period may be calculated:

$$\text{energy losses} = \text{loss factor} \times \text{peak loss} \times \text{No. of hours} \qquad (3)$$

$$\text{where loss factor} = \frac{(\text{Average kva})^2}{(\text{peak kva})^2}$$

A well-known empirical formula linking loss factor and load factor (average kva/peak kva) is:

$$\text{loss factor} = 0.7(\text{load factor})^2 + 0.3(\text{load factor})$$

This expression was derived from field tests carried out in 1928[1]. A large number of test readings were obtained in Consumers Power Co service area in 1958 which confirm that, under present load conditions, this formula should now read:

$$\text{loss factor} = 0.9(\text{load factor})^2 + 0.1(\text{load factor})$$

If load factor is assumed to be 0.5, then loss factor is 0.275. Combining formulae (1) and (3) above and charging energy lost at $0.003 per kwhr, the cost of yearly losses due to line resistance on a 3-phase grounded line is:

$$C_2 = 0.275 \times \frac{\text{kva}^2}{E^2} \times \frac{rD}{1{,}000} \times 8760 \times 0.003$$

$$= 0.0072 \times \frac{\text{kva}^2}{E^2} \times rD \qquad (4)$$

Some loads are not affected by voltage drop. An induction motor will take a ±10% variation in voltage without changing kwhr usage[2]. Resistance loads controlled by thermostats will generally use a constant kwhr for reasonable voltage variations. However, uncontrolled resistance loads will use less kwhr with reduced voltage. It is estimated that over the range of

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Table I

Total Loss Constant / Mile					
Cu	ACSR	Misc.	1-ϕ Wye	1-ϕ Delta	3-ϕ Wye + Delta
4/0	335				0.0080
1/0	3/0		0.0461	0.0324	0.0157
2	1/0		0.0722	0.0506	0.0244
3			0.0907	0.0636	0.0307
4	2	4 ACW	0.1129	0.0793	0.0382
6	4	6 ACW	0.1787	0.1255	0.0606
8			0.2835	0.1991	0.0960
		5 CW	0.4589	0.3217	0.1551
		6 S	0.8957	0.6322	0.3036

Table II

Total Loss Constant Per 1,000 Ft					
Cu	ACSR	Misc.	1-ϕ Wye	1-ϕ Delta	3-ϕ
4/0	335				0.0015
1/0	3/0		0.0087	0.0061	0.0030
2	1/0		0.0137	0.0096	0.0046
3			0.0172	0.0120	0.0058
4	2	4 ACW	0.0214	0.0150	0.0072
6	4	6 ACW	0.0338	0.0238	0.0115
8			0.0537	0.0377	
		5 CW	0.0869	0.0609	
		6 S	0.1694	0.1197	

voltage drops normally experienced, the reduction per 1,000 kwhr recorded is 16.5 times the volts drop and that residential customers use about 300 kwhr yearly which is affected in this way. Fig 1 shows the extent of revenue loss for varying voltage drops and for a varying number of customers.

Assuming diversified demand per customer is 1.0 kva and net potential revenue per kwhr is $0.0025, the revenue loss for 3-phase grounded lines is:

$$C_3 = \frac{16.5 \times \text{kva} \times \text{kD} \times 120}{1{,}000 \times \text{E}/\sqrt{3}} \times \text{N} \times \frac{300}{1{,}000} \times 0.0025$$

$$= 0.00258 \frac{\text{kva}^2}{\text{E}} \times \text{kD} \qquad (5)$$

where k = voltage drop factor $= \frac{\text{R} \cos \theta + \text{X} \sin \theta}{\text{kv}}$

Combining the three cost formulae for primary line losses the total cost (in dollars) for 3-phase grounded lines is:

total line loss = peak demand loss + energy loss + revenue loss

$$\text{T} = \text{C}_1 + \text{C}_2 + \text{C}_3$$

$$= 0.0255 \frac{\text{kva}^2}{\text{E}^2} \times \text{rD} + 0.0072 \frac{\text{kva}^2}{\text{E}^2} \times \text{rD} + 0.00258 \frac{\text{kva}^2}{\text{E}} \times \text{kD}$$

$$= (0.0327\text{r} + 0.00258\text{kE}) \frac{\text{kva}^2}{\text{E}^2} \times \text{D}$$

$$= \frac{\text{kva}^2 \times \text{D}}{\text{E}^2} \times \text{L} \qquad (6)$$

where L = line loss constant per mile or per 1,000 ft

Line loss constants for single-phase and delta-connected lines have also been derived and values have been obtained for various common wire sizes and operating voltages. These are shown in Tables 1 and 2.

If primary line voltage drop calculations are already being made in which line loads are estimated by sections, the above technique can be applied as required with a minimum of manual compilation. Where extensive studies are undertaken, this method can be used in conjunction with voltage drop calculations on a computer.

Some basic information which the formula shows is:

(1) Losses increase as the square of the load. A yearly increase of 10% in load is therefore accompanied by a 21% increase in losses.

(2) Losses vary inversely as the square of the primary line voltage.

(3) The effect of varying power factor on the cost of yearly losses is shown in Fig 2.

(4) Fig 3 shows the cost of yearly losses in dollars for various wire sizes on 3-phase, 8,320-v lines. Curves for other common voltages can be calculated in the same way.

References:

(1) "Load Factor-Equivalent Hour Values Compared," F. H. Buller and C. A. Woodrow, EW, July 14, 1928, p 59.

(2) AIEE Pamphlet No. 952, Electric Power Distribution for Industrial Plants, 109 pp.

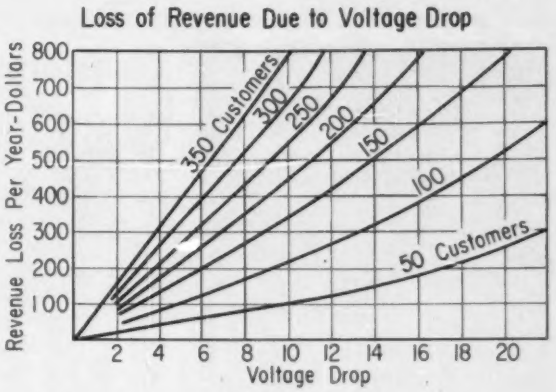


FIG 1—REVENUE LOSS in dollars per year due to voltage drop is shown. Some loads are not affected by changes

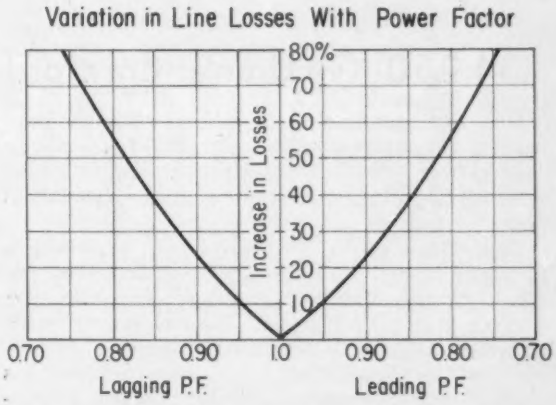


FIG 2—VARYING POWER FACTOR causes a change in line losses. Reduction, either leading or lagging, is detrimental

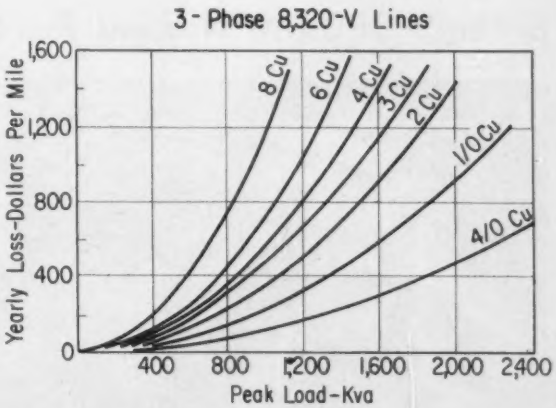
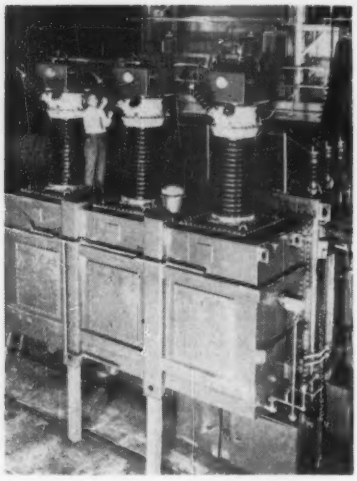


FIG 3—COST OF YEARLY LOSSES varies with wire size. Smaller sizes can cause rapid increase in year's loss values



Transformer Has New-Type Tap Changer

The 200-Mva, forced air cooled power transformer (left) recently was shipped by Westinghouse Electric Corp to New York State Electric & Gas Co. Installed at the Gardenville, N. Y., station, the unit will step down voltage from 230 to 120 kv. Westinghouse says it believes it is the largest such unit in the US with resistance-switched, high-voltage load tap changer.

The tap changer, Type URH, serves two purposes: its in-phase, resistance-type transfer switch increases contact life and also reduces weight of the transformer 10% and shipping length 25%, compared with the weight and length of conventional transformers using tap changers with series transformers and preventive autotransformers.

Elimination of the series and preventive autotransformer in the unit also results in decrease in losses of the over-all unit, says Westinghouse. Size of the unit is thus further cut down, because fewer radiators are required for cooling.

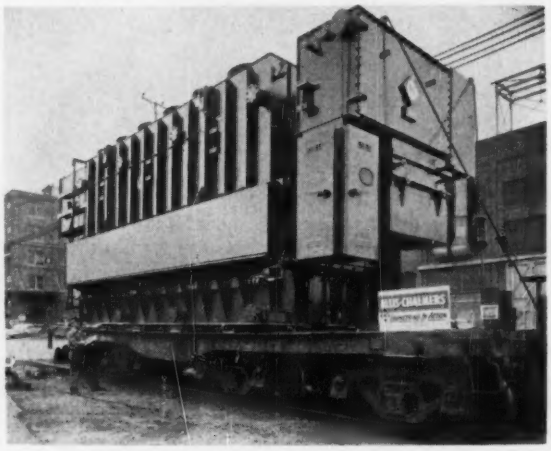
The selector switch is attached to the lower end of the large porcelain bushing; the transfer switch on top. Connections are inside bushing.

404,250-Kva Unit at Crawford

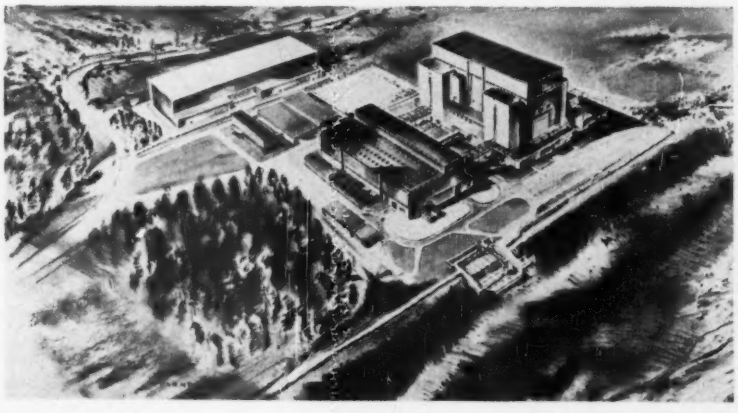
This 3-phase transformer with an equivalent two-winding capacity of 404,250 kva (right) is shown being shipped from Allis-Chalmers Manufacturing Co's West Allis Works for installation in Commonwealth Edison Co's Crawford Station, Unit No. 8.

Low-voltage winding is 385 Mva at 12 kv; two high-voltage windings, each 211,750 kva, will feed two 138-kv systems. Each high-voltage winding has ±10% load-tap-changing equipment. The unit will be forced oil cooled with oil-to-air heat exchangers.

Despite its size of 36x18x19 ft, the transformer was shipped upright, complete except for bushings, Electro-Cooler units, and insulating oil. A 250-ton railroad car was used. Unit is 673,000 lb, installed. This is another step in Crawford's modernization.



Britain's 580-Mw Nuclear Plant to Feature Compact Design



Contracts for the $155-million, 580-Mw nuclear power plant which will be built at Sizewell, Suffolk, for Britain's Central Electricity Generating Board recently were awarded to English Electric Co, Ltd, Babcock & Wilcox Co, and Taylor Woodrow Atomic Power Group. Compactness is the keynote of the station's design, which marks a departure from previous British nuclear power stations: both reactors are housed in a composite building (see largest building, left).

Two 325-Mw turbogenerators will

(*Continued on page 74*)

11,078,750 KW

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including only those installations operating at 900 p.s.i. or more, and costing $50,000 or more!

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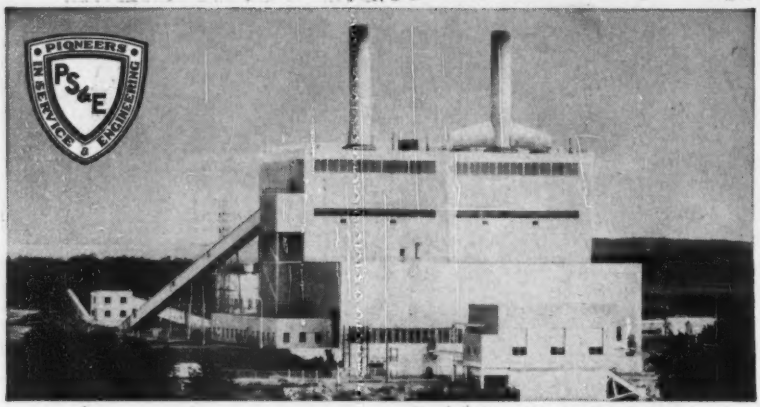

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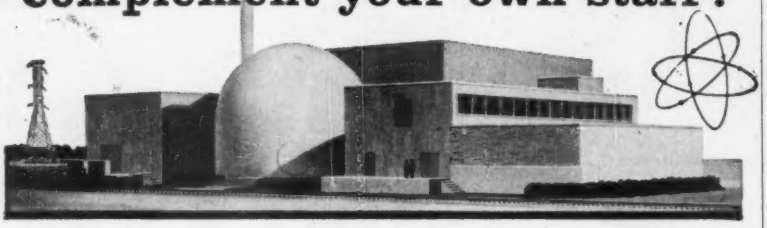

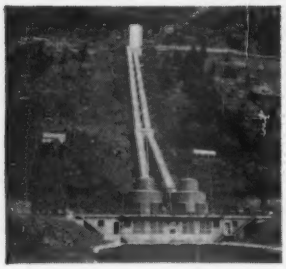

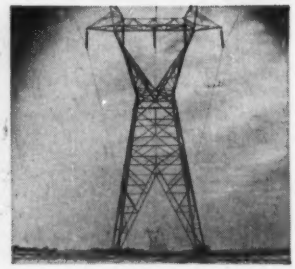

DESIGN AND CONSULTING ENGINEERING SERVICES

Pioneer specializes in designing power plants and offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and construction management. Pioneer's other services include substation, transmission and distribution studies and design.

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CORPORATE SERVICES

Pioneer offers its services as business and management consultants; stock transfer and dividend disbursing agents; financial, accounting and tax consultants.

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be used at Sizewell, compared to six main and three smaller generators to be installed at Hinkley Point atomic power station. The latter plant was designed three or four years ago, and is now being built by the power group.

Sizewell will add 80 Mw more than Hinkley Point to the national supergrid and will be the seventh nuclear power station to be ordered, bringing England's total nuclear power to 3,000 Mw. A target of 5,000 Mw has been set for 1968.

Whereas Hinkley Point will generate at a cost of about 8.4 mills per kwhr, later designs are being offered to the UK making possible a reduction of 6.6 mills at 75% utilization factor.

Space between the reactors will be used for common supervisory control, service, and plant rooms. A concrete shield floor above the reactors will extend from one to the other and a maintenance shop will transfer reactor fueling and servicing machinery as needed. Boilers will be shielded to eliminate reactor safety fence.

Eight boilers are to be used at Sizewell, compared with the twelve to be used for the 500-Mw Hinkley Point. Each is only slightly larger than its Hinkley Point counterpart, but will produce over 50% more steam at higher temperatures and pressures. Drum pressure is 720 lb psi abs; superheater outlet temperature is 736F.

MANUFACTURERS BRIEFS

Cornell-Dubilier Electronics, division of Federal Pacific Electric Co, has transferred its corporate headquarters to Newark, N. J., from South Plainfield, N. J., but manufacture of power factor capacitors and energy storage capacitors will be continued at the latter location. The move is expected to bring about a closer working arrangement between C-D E and Federal Pacific.

The first vehicle powered by self-contained fuel cells—a research tractor—recently was presented to the Smithsonian Institution by **Allis-Chalmers Mfg Co.** Electricity to drive the vehicle is derived from the tractor's fuel by 1,008 fuel cells.

(*More News of Manufacturers, p* 88)

New 15 kv G&W Oil-Fuse Cutouts are full-rated for 110 kv BIL duty!

G&W Type FC72, 15 kv Oil-Fuse Cutouts have full 110 kv BIL and high interrupting ability for today's distribution circuits. Impulse withstand level is 110 kv under standard 1½ x 40 microsecond wave and 60-cycle one-minute withstand is 50 kv.

The Type FC72 Cutout can interrupt 7000 amperes asymmetrical (4200 amperes symmetrical) on single-phase operation at 13.8 kv, or 100,000 kva, symmetrical, on three-phase applications. Continuous-current rating is 200 amperes. It can break load currents up to 300 amperes where power factors are 50% or higher and can break magnetizing and load currents of 100 amperes at power factors of 20% or less. Metal-to-metal flanged surfaces with retained gaskets and a heavy wall dome area make this device applicable for use in hazardous locations.

The new G&W 15 kv Cutout is safe, simple to install, easy to operate, and requires little maintenance. In-line construction with operating shaft running horizontally through the cutout dome makes possible coupling of gang-operated cutout shafts in a straight line. Operating handle rotates beyond dead center to lock both "On" and "Off" positions. The interrupter unit with fuses and replaceable switch contacts is raised into the dome above the oil when the cutout is switched to the "Off" position. They are accessible when dome is swung back on its hinge. Dome cannot be opened while switch is in the "On" position.

Repeated tests of the G&W Type FC72 Oil-Fuse Cutout show it will operate five times at full interrupting rating before inspection or replacement of oil is needed.

Contact your G&W representative for complete information, or send for Catalog CC.

G&W ELECTRIC SPECIALTY COMPANY

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CANADIAN MFR. • POWERLITE DEVICES LTD. • TORONTO, MONTREAL & VANCOUVER

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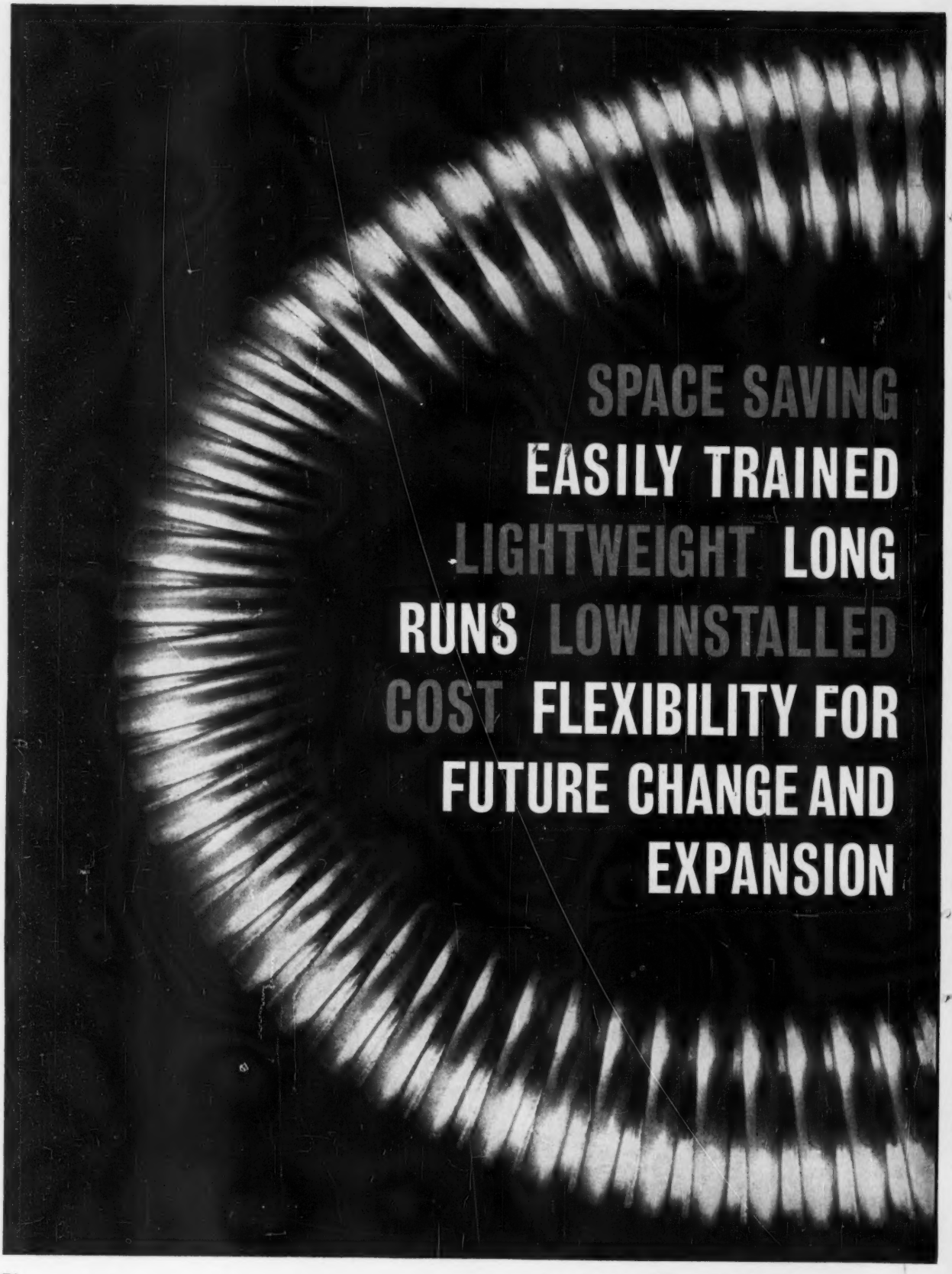
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RUNS LOW INSTALLED
COST FLEXIBILITY FOR
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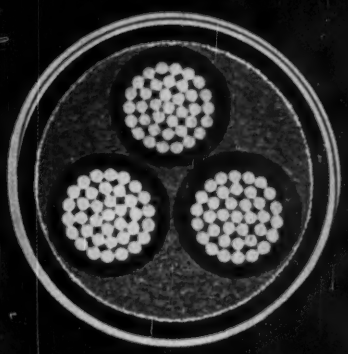
GENERAL CABLE

INTERLOCKED ARMORED CABLE

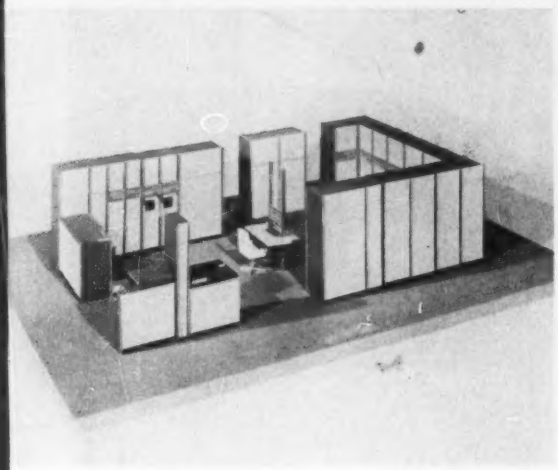
For full protection under all conditions install General Cable Interlocked Armor...the cable for power, control, communication and lighting systems. This compact, versatile cable is available in a wide range of constructions, insulations, armors and voltage ratings. Colored polyvinyl chloride jacket over the armor can be furnished where required. "How to Obtain the Greatest Advantage Per $ Spent" a comprehensive folder detailing General Cable's complete line of Interlocked Armored Cables is available upon request. **General Cable Corporation**, 730 Third Avenue, New York 17, New York. Offices and Distributing Centers Coast-to-Coast.



New Equipment

Oil Level Gauge . . .

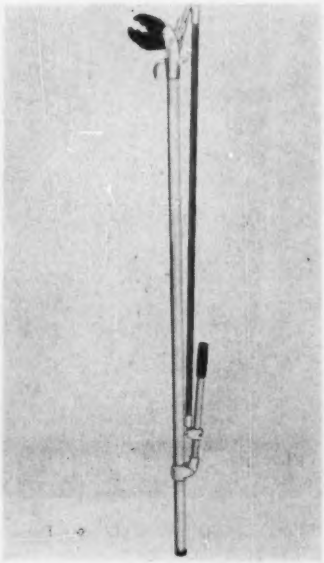
. . . features long-life ceramic magnet to withstand demagnetizing surges of over 100,000 amp. For use on the Lapp POC and POC-A line of 15 to 196-kv standard bushings, the new guage contains two 'cermet' permanent magnets—one geared to the float in the oil reservoir, the other on the dial indicator outside of the reservoir housing—which activate the guage through the reservoir wall to indicate the bushing's oil level. The high coercive force of the new cermet material makes it well suited for retaining high magnetic strength despite stresses of heavy current, short circuit surges.
Lapp Insulator Co, Inc, Insulator Div, Gilbert St, Le Roy, N. Y.



Digital Computer . . .

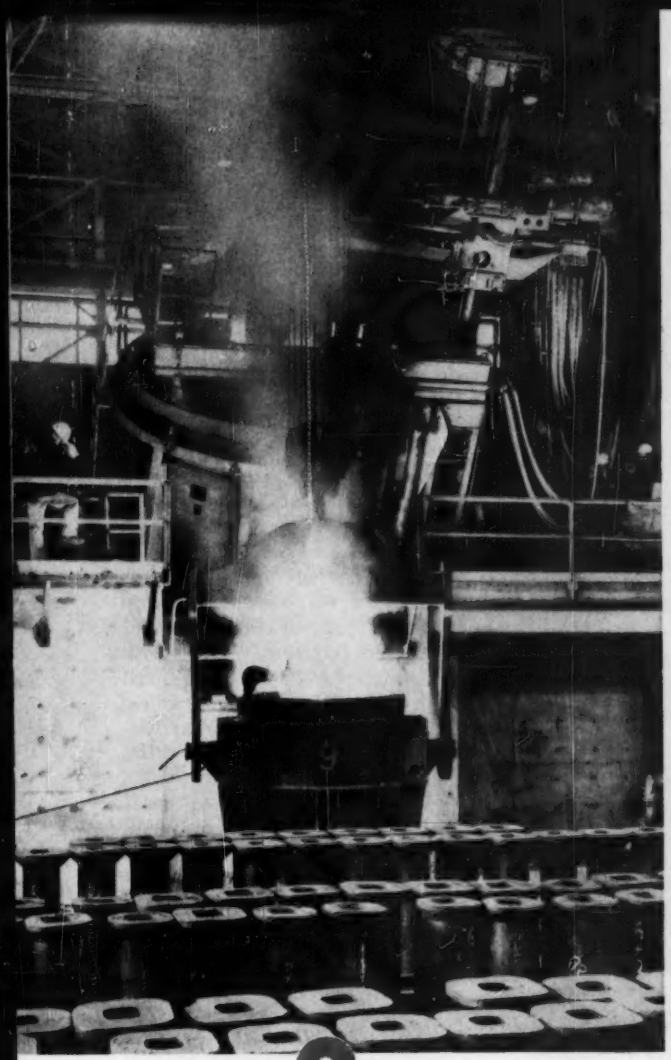
. . . features thin magnetic film memory which permits internal referencing rates at speeds measured in billionths of a second. The Univac 1107 system is designed to solve both complex problems off-line and real-time problems on-line. The solid-state system has 16 arithmetic registers, 15 index registers with automatic incrementation, and partial word transfer capabilities. In addition to the film memory, the system employs a ferrite-core memory of from 16,384 to 65,536 words.
Remington Rand Univac, 315 Park Ave South, New York, N. Y.

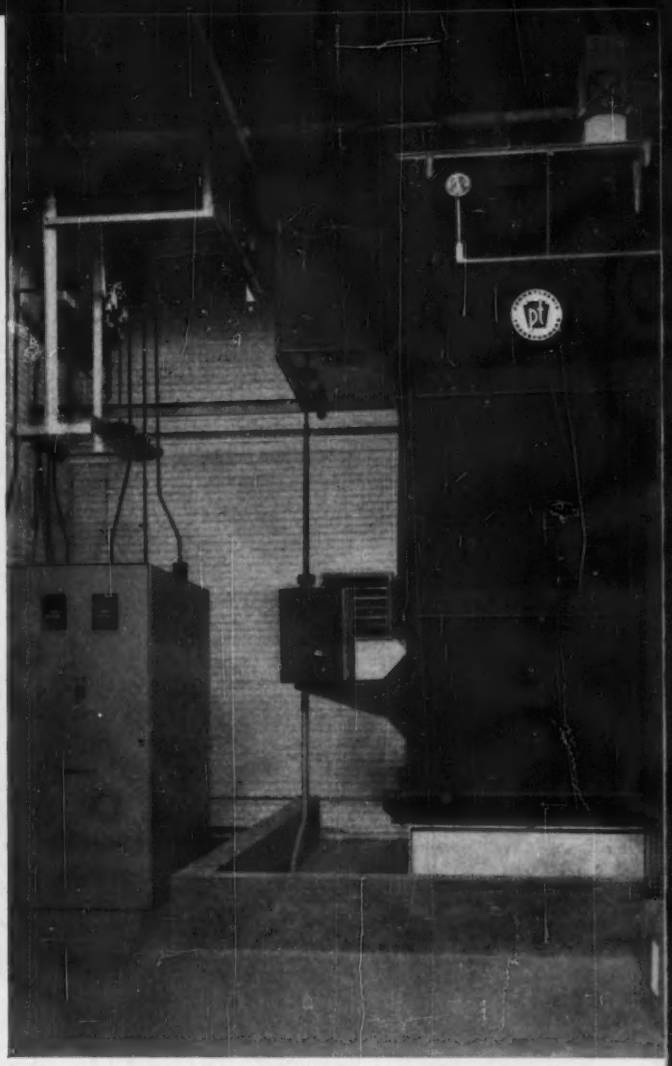
Hot Stick . . .



. . . has high mechanical force lever for compressing sleeves and connectors, or for cutting conductors. The same basic stick will accommodate a wide variety of mechanical compressor jaws (K-O-51, K-O-52, N-51 or N-52 and B-MD-5). Full tension compression sleeves up to 2/0 ACSR, and strand aluminum sleeves up to 3/0 may be installed with this live line tool. It will also take Porter No. 1 bolt cutter jaws. The stick is available with maximum hardness center-cut Porter bolt cutter jaws for cutting hard and soft conductors. Maximum cut rate is 4/0 ACSR. The lever action is adjustable to compensate for wear or to adapt to various jaw assemblies. Stick is available in tenkote hardwood, and medallion or Glastrux Fiberglas.
Bodendieck Tool Co, Rt 48 North, Taylorville, Ind.

(*More New Equipment on page* 80)





7500-kva, water-cooled (Class OW), Pennsylvania Furnace Transformer with motor-operated tap changer, located in vault, supplies No. 3 arc furnace at Lemont Manufacturing Corporation. Pour is being made from the Lectromelt size "NOT" furnace, to fill the billet-size ingot molds.

for the 3RD time...

Steelmaker picks Pennsylvania electric arc furnace transformer

Lemont Manufacturing Corporation, the principal industry of Lemont, Illinois, recently increased by 50% its capacity to produce carbon steel for rolled structural shapes. The latest addition to this modern plant is a third 12-foot diameter Lectromelt Arc Furnace, supplied with power by a *third 7500-kva Pennsylvania Furnace Transformer*. Each of these furnace and transformer installations is capable of producing pours of 20 net tons at a rate of 7½ to 8 tons per hour—a ton every 7½ minutes.

In supplying power to melt this steel, the transformers do their job in a very unspectacular way. Externally, there is no hint of the internal "beating" they take. They must withstand high overloads and the repeated stresses caused by short circuits at the furnace electrodes. Yet, Lemont expects and *gets* dependable, trouble-free, day-in and day-out service from each of its three Pennsylvania Furnace Transformers.

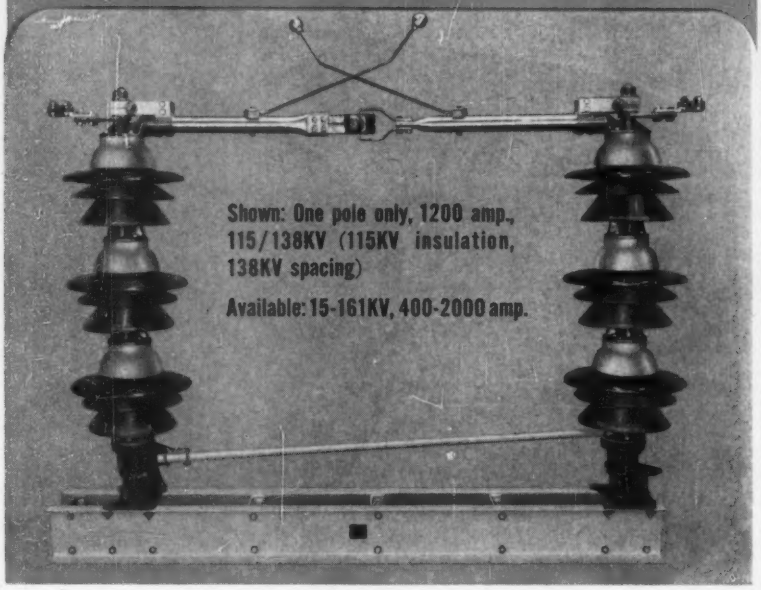
Especially rugged in construction, Pennsylvania Furnace Transformers also have the inherent strength provided by a special winding design proven by 25 years of applicatiori. The design has been successfully applied to ratings as high as 40,000 kva and 82,000 amperes.

To take advantage of Pennsylvania's design experience and to obtain information on furnace transformer construction, contact Power Transformer Sales Dept., Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pennsylvania.

PENNSYLVANIA FURNACE TRANSFORMERS

USCO TYPE GCH-3

The center-break switch that offers ECONOMY with ENGINEERING QUALITY



Yes...you can cut line & station construction costs & still get the best!

Design engineers throughout the country are adopting the new USCO GCH-3 as standard. They report that the GCH-3 not only meets the strictest engineering requirements, but that it wins the praise of budget-conscious management. More and more utility companies are getting GCH-3 economy and quality*. Check advantages listed below and see how you can do the same!

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- Exceeds NEMA Specifications
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- Functions perfectly in *any* mounting position
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Include the GCH-3 in your next switch study ... send your inquiry to USCO today!

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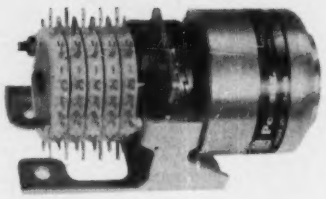


Selector Switch . . .

. . . is solenoid driven. The standard PACSOL 'D' size rotary solenoid steps 360 deg in 30 deg increments and is single pulse operated—for continuous and intermittent duty. A positive roller detent mechanism, with an anti-overshoot feature, is standard on all units. Drive is jam-proof with ratchets riveted to their shafts to eliminate twisting and cocking. The drive package, plus its closely coupled detent mechanism, measures 1-⅝ in. in length and after wiring may be fitted in a 1-½ in. dia tube. Each wafer switch stacked on the output shaft adds only 11/64-in. to the units total length. The PACSOL 'D' rotary solenoid will pull up to ten wafers at 60-w input or less.

Licon Div, Illinois Tool Works, 6606 W Dakin St, Chicago, Ill.

Phase Sequencer . . .

. . . for 120, 240, and 480-v, 60 and 40-cycle, 3-phase power systems. Portable pocket-size indicator, 2⅞ x 1⅝ x 4 in., provides phase sequence identifications for installation of 3-phase electrical equipment.

Associated Research, Inc, 3758 W Belmont, Chicago, Ill.

Lantern . . .

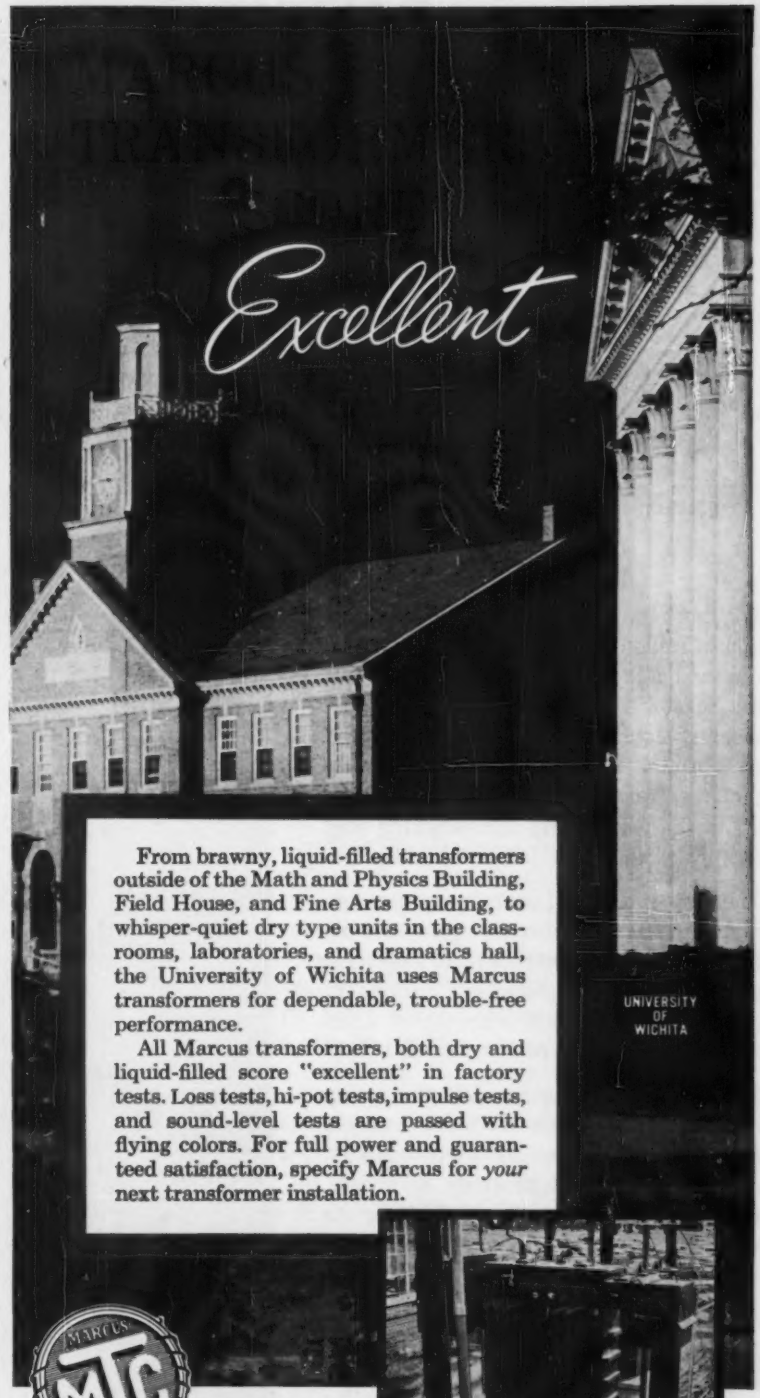
. . . with bright white spot prefocused and red flash has handle that makes it easy to carry, hang on a wall or place on the ground. Mounted on flat surface of handle, lantern can be positioned at any vertical angle through 330 deg. Its reflector is protected with an unbreakable Bezel-type lens. Dome stores two spare bulbs.

Union Carbide Consumer Products Co, Div of Union Carbide Corp, 270 Park Ave, New York 17, N. Y.

Relay Panel . . .

. . . for outdoor oil circuit breakers can be cut with a hacksaw and is non-combustible. The panel, for use with A-C Type OZ and Type FZO outdoor OCB's also has new wiring ducts at its rear to eliminate lacing in the field. With new wiring duct, it is only necessary to lay wires in place and snap on cover.

Allis-Chalmers Mfg Co, Milwaukee 1, Wis.



From brawny, liquid-filled transformers outside of the Math and Physics Building, Field House, and Fine Arts Building, to whisper-quiet dry type units in the classrooms, laboratories, and dramatics hall, the University of Wichita uses Marcus transformers for dependable, trouble-free performance.

All Marcus transformers, both dry and liquid-filled score "excellent" in factory tests. Loss tests, hi-pot tests, impulse tests, and sound-level tests are passed with flying colors. For full power and guaranteed satisfaction, specify Marcus for *your* next transformer installation.

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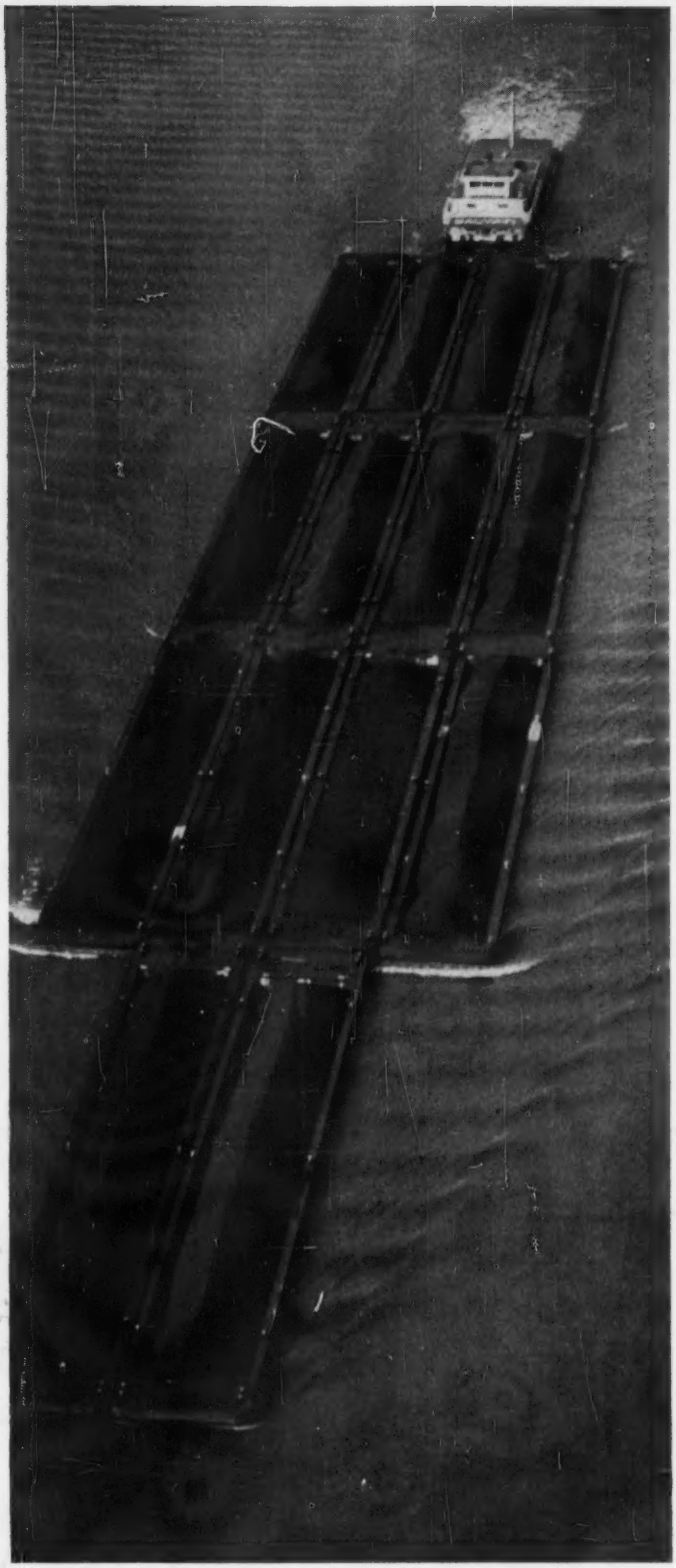
MARCUS TRANSFORMER CO., Inc.

RAHWAY, NEW JERSEY

A COMPLETE LINE OF DRY TYPE AND LIQUID-FILLED TRANSFORMERS THRU 5000 KVA

how does 1970 look... from here?

(and how about 1980?)



The most look-ahead industry in the nation is undoubtedly the electric utilities. Glance back over the past 10 years and the reason is obvious. And with even greater electric needs forecast for the next 10 and 20 years, it's not surprising that any remaining short-term thinking about the way to buy *coal* is giving way rapidly to the same *long look ahead.*

There is increasing awareness that behind an attractive invoice price can be the hidden incremental costs of excessive coal handling, ash handling, equipment outages, freight charges on inerts, operating inefficiencies of many kinds.

There is increasing interest in quality coal that delivers *steam* at the lowest *net* cost. There is increasing interest in adequate reserves, in uniformity of supply, in suppliers in a position to deliver the right kind of coal on a reassuring long-term contract basis.

An increasing number of utilities are looking to Island Creek as a supplier of such coal . . . and such reassurance. We'd welcome a chance to discuss this matter more specifically with you. Write, wire or phone.

You can depend on Island Creek . . . a career company dedicated to coal

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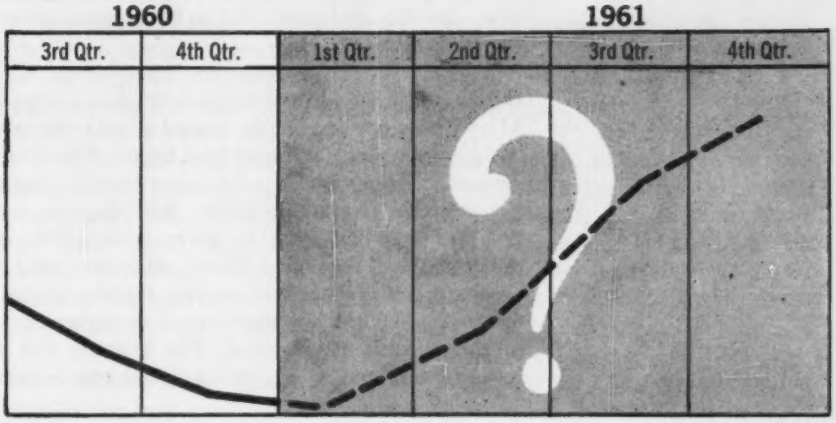
Electrical World

DECEMBER 26, 1960

Management Newsletter



Soaring Sixties?

The "soaring Sixties" didn't get into orbit as the long range forecasts assured us they would. But then again, they didn't exactly explode on the pad. Some indicators will tell you that 1960 was a pretty good year. Gross National Product, the most comprehensive of the economic weathervanes, reached a record high rate of $505 billion per year in the second quarter. Automobiles were strong from start to finish with 6.75 million domestic units produced. This was the industry's best performance since 1955 when the figure was 7.9 million. Capital spending was high too, in fact, the second best year on record.

Then why all the pessimism in business circles? The first reason is psychological. When you look back to the forecasts for 1960, you find that the year fell a good deal short of expectations. This, of course, was discouraging, and discouragement is contagious among business men. But the second reason for pessimism is more important. The economy has been showing a trend since early this year—a downward trend.

Some indicators were weak from the start. Construction, which had proceeded at an annual rate of $41.3 billion in the second quarter of 1959, had slipped to $40.8 billion by the end of the first quarter of this year, and was down a bit further in the second quarter. The heart of this construction sag was to be found in non-farm residential building which dropped $2.4 billion by the second quarter of '60 from the corresponding period of a year before.

Corporate profits were gloomy too. Typical statements pointed to record sales but low earnings. First National City Bank of New York reported that in the third quarter, manufacturers earnings were off 4% from last year (adjusted for steel strike). The Federal Reserve index of industrial production (1957=100) started the year at 111, and slid continuously, dropping close to 106 early in the fourth quarter. After analyzing the picture, the stock market skidded from January's 685 Dow-Jones average to a late October level of 569.

Other indicators started strong, but broke abruptly in mid-1960. Steel boomed as stocks were rebuilt during the early part of the year following the steel strike of 1959. Then the operating rate began to drop, settling to just a shade above 50% in the third quarter, and going below 50% early in the fourth. The McGraw-Hill index of new machinery orders (1950=100) fell four points from a high second quarter, and dropped eight more points to a fourth quarter level of 168. And Gross National Product fell from its record high of $505 billion to $503 billion in the third period.

Economists, looking for a reason to explain the skid, found some ready whipping boys. But the chief culprit had to be the giant inventory draw-down which started early in the year.

In January, in the wake of the steel strike, industry was accumulating inventories at $11.4 billion per year. In the second quarter, the rate plunged to $5.3 billion, and in the third quarter, it was at $0.6 billion. The effect of this inventory depletion is obvious. Manufacturers have been meeting part of their rising end demand out of their inventories rather than through new production. So, production has been cut back to lower levels (79% of capacity in September as against 85% at the end of 1959) and is continuing at these lower levels awaiting reports that warehouses are empty. But the inventory draw-down can't continue indefinitely. When inventories reach a replacement status, production will have to rise to meet end demand. The question that economists ask as they look toward the future, is just what will that end demand be?

Some of the weathervanes are pointing up. 1961 automobiles are selling at the best rate since the 1955 car boom. While this picture may well change with time, the early reports are highly encouraging. Personal income rose throughout most of the year, hitting $409.6 billion per year in the fourth quarter, up from October '59's $384 billion. This means that consumers have the buying power to trigger an upturn. And if there's any consumer reluctance to buy, it's rather slight. True, demand has been weak in some areas, particularly durable goods. And installment debt has been declining (the $300 million a month figure in the first half was down to $130 million in October). But demand for total goods and services has risen. End demand was at $490 billion in the first quarter, and rose to $500 billion in the second. This figure jumped again, bucking the trend of a generally dreary third quarter and reached an annual rate of $503 billion. When these figures are compared with the general slump of the third quarter, their performance is amazing, and reflects great underlying strength in the economy.

Bolstering this strength is the strong probability of increased government spending. This spending will probably be moderate. The incoming administration will be hampered in any pump priming activities by the spectre of inflation, and the consequences of inflation on the nation's balance of payments situation. But statements by Senator Kennedy, as well as the tone of the Democratic platform, seem to indicate that the new government will support some increase in defense and space spending, and increased welfare and area relief programs. These may total to a $3-billion increase in Federal spending.

Money supply, which takes most of the blame for the poor showing in residential housing, should be expanding. The Federal Reserve has made an additional $1.3 billion of reserves available to the banking system through adjustments in vault cash and reserve requirements. And there are no indications that the Fed is planning to pull in the reins again in the near future. Money costs may ease a bit as well. While a slashing drop in interest rates seems out of the question in view of the flow of gold abroad, steps will probably be taken to alter the structure of interest rates. Action by the Federal Reserve during the past few months indicates a departure from the "bills only" theory that has prevailed during recent years. And the President-elect has said repeatedly that he feels long term rates can come down somewhat without chasing investments overseas.

Along with a larger money supply, and slightly lower interest rates, consumers are indicating a greater desire to buy. Consumer plans for buying new homes, according to a National Industrial Conference Board survey, are up 11% over 1959.

But even this demand does not measure up to the expectations of earlier this year. As a result, industry is adjusting to what now seems to be a more realistic demand picture. And in the process of this adjustment, manufacturers have suffered a 5% drop in incoming orders since the spring. McGraw-Hill's survey of preliminary plans for capital spending showed that manufacturing companies will spend 3% less for new plant and equipment than they did in 1960. What's more, revisions to these estimates have generally been downward. It now seems quite possible that the cut in capital spending may be nearer to 6%. This not only indicates that manufacturing will not expand enough to employ the growing work force, but also omens a rocky first half for the capital goods industry.

In 1961, look for new plant and equipment orders to hit bottom during a slack first quarter. This will cause a cutback in production and send the Federal Reserve index down toward the 100 level. Rockbottom for manufacturers should come early in the second quarter of 1961. This cut in production will be felt heavily by the labor force. Unemployment will pass the 5 million mark in the second quarter. But this drop in manufacturing will not be reflected proportionately across the entire economy.

Other segments of the economy will be growing stronger. Non-residential construction has been rising and will continue to do so. Government contracts, and perhaps changes in depreciation structure may even step up the pace. In addition, increased mortgage money should push housing starts upward, making construction a bit stronger in 1961 than it was during this year.

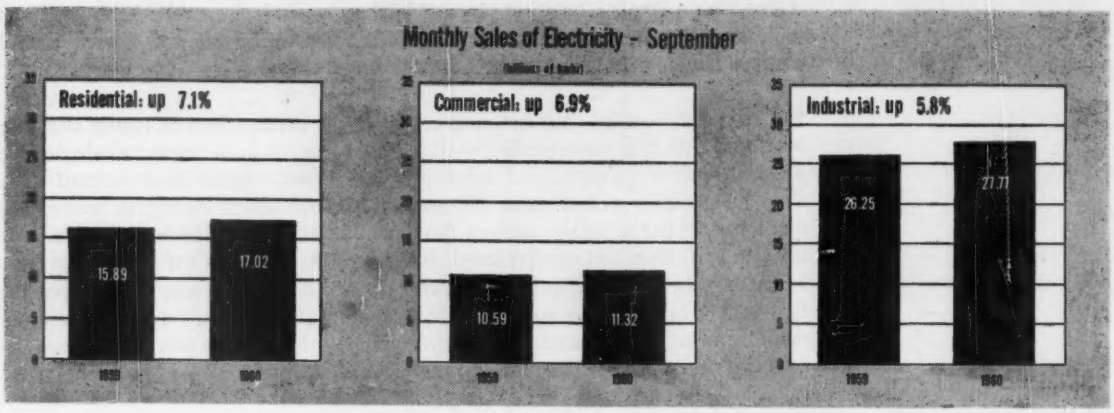
Service industries will continue to expand. Americans spent in the neighborhood of $132 billion for services in 1960, and will probably be spending $139 billion in 1961. Net farm income will also weather the storm. It should remain about the same in '61 as it was this year—$11.4 billion.

American products will continue to grow in popularity abroad. Exports rose $3 billion in 1960 to a total of $19 billion for the year. All indicators point to further increase in 1961, perhaps to a level of $20 billion.

Then too, the effects of unemployment on consumer income and consequently on demand, will not be as great as they were during the classic recessions of the past. This is because the layoffs will trigger the so called built-in stabilizers assuring the unemployed of a substantial portion of their buying power. You can probably count on the government to follow the precedent of the 1958 slump, and to extend the periods of unemployment coverage if the set-back becomes prolonged.

With manufacturing the only major sector of the economy headed for trouble next year, how will the Gross National Product fare? The sign posts seem to indicate that GNP will continue to drop through most of the first quarter due to cutbacks in manufacturers' inventories. The first quarter figure should be close to $502 billion per year. The rise in production will come sometime during the second quarter as industry starts restoring inventories at a conservative rate. This will be accompanied by an increase in new orders for plant and equipment. GNP at the end of the second quarter, responding to the stepped-up pace of business, should be back over $505 billion. By the middle of the third quarter, the signs of strength will be evident throughout the economy.

The soaring Sixties probably won't get off the ground in 1961 either. With the business slump extending late into the first quarter, or early second quarter, 1961's figures shouldn't be any better than 1960's. But at least the inventory adjustment will be over, setting the scale for substantial gains in 1962.



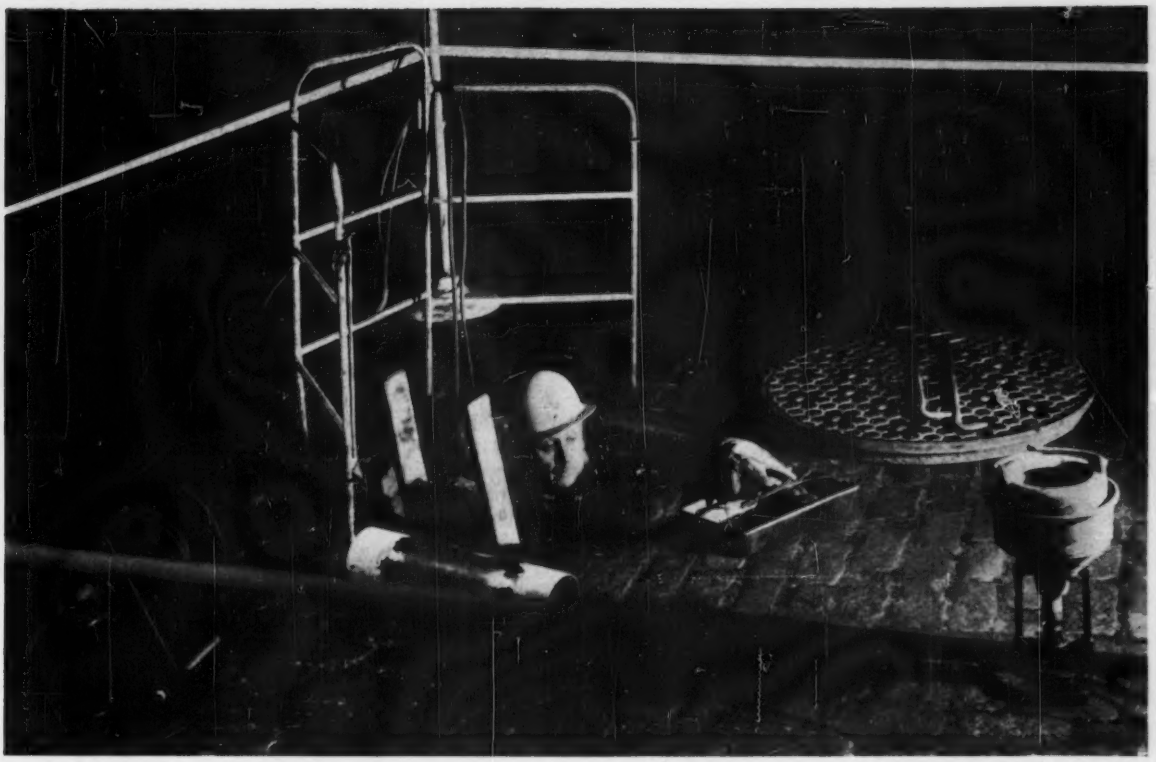
Power Statistics

		Latest Month	Year Ago	Annual Change %
Capacity	Sept.	164.51	154.52	6.5
Dec. '59 Peak } million kw		121.6	113.5	7.2
Est. Dec. '60 Peak	Sept.	133.8	134.3	−0.4
Production—billion kwhr	Sept.	62.58	58.58	6.8
Hydro		11.44	10.26	11.5
Fuel		51.14	48.32	5.8
Sales—billion kwhr	Sept.	59.62	55.92	6.6
Residential		17.02	15.89	7.1
Commercial		11.32	10.59	6.9
Industrial		27.77	26.25	5.8
Other		3.51	3.20	9.7
Fuel Consumption	Sept.			
Coal—million tons		13.89	13.21	5.1
Oil—million barrels		5.90	5.85	0.9
Gas—billion cu ft		177.48	169.49	4.7
Net Income Class A & B Co's—$ million	Sept.	147.70	139.77	5.7
Residential Customers—millions	12 mos.	49.77	48.65	2.3
Revenue per kwhr	ended	2.47¢	2.51¢	−1.6
Avg kwhr per customer	Sept. 30	3,756	3,517	6.8
Avg annual bill		$92.77	$88.28	5.1

Business Statistics

Indexes: 1947–49 = 100				
FRB Industrial Production	Oct.	166	160	3.8
ENR Construction Cost	Dec.	174.1	169.6	2.7
BLS Cost-of-living	Oct.	127.3	125.5	1.4
New Orders for Machinery (1950 = 100)	Oct.	162	166	−2.4
NEMA Sales				
Insulation materials	Sept.	142	160	−11.3
Electric appliances	Sept.	104.2	120.9	− 9.7
Wholesale prices				
Motors and generators	Sept.	141.1	144.8	−2.6
Transformers and regulators		141.6	149.7	−5.4
Switchgear and fuses		171.2	178.5	−4.1
GNP—annual rate—$ billion	3rd qtr.	492.7	480 0	2.6

Significant Changes: September wholesale price index for switchgear and fuses hits lowest since December, 1957. Transformer and regulator prices were also at lowest index in four years.



Where Will You Get New Capital For The **POWER-HUNGRY '60's?**

The privately owned electric utility industry plans to spend $3.5 billion on new and improved facilities in 1961. And over the next five years it expects to spend nearly 15% more on expansion than it has in the past five.

Vast new capital funds will be required. They will come from the individual and institutional investors who are the substance of American free enterprise.

As a vital, creative link between the electric utility industry and money sources, Kidder, Peabody has long experience and leadership in raising debt and equity funds through private placements and underwritings.

Last year, Kidder, Peabody & Co. and Kidder, Peabody & Co. Incorporated took an active part in the underwriting, sale and distribution to the public of 62 new utility issues amounting to more than $1,518,000,000.*

Our 27 offices coast-to-coast have the extensive contacts and facilities needed to achieve a prompt, economical distribution of new issues. Our experience and long-established connections with private and institutional investors bring us, every year, large quantities of private placement business. Call us for detailed information on how we could help your company meet its requirements for additional capital in the powerful decade ahead.

*A partial listing of recent issues

Alabama Power Company
Brockton Edison Company
Carolina Power & Light Company
Central Hudson Gas & Electric Corporation
Central Louisiana Electric Company, Inc.
Community Public Service Company
Delaware Power & Light Company
Fall River Electric Light Company
Florida Power Corporation
Florida Power & Light Company
Georgia Power Company
Idaho Power Company
Interstate Power Company
Kansas Gas & Electric Company
Louisiana Power & Light Company
Maine Public Service Company
New York State Electric & Gas Corporation
Pacific Power & Light Company
Pennsylvania Electric Company
Public Service Company of New Hampshire
South Carolina Electric & Gas Company
Southern Nevada Power Company
Tampa Electric Company
Texas Power & Light Company
Upper Peninsula Power Company
Washington Water Power Company
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Hi-Line Hardware History Documented

Brewer-Titchener reviews cycles of progress in designs and materials in an historical record of improvements

In its recently-released "History of Hi-Line Hardware Since 1882" Brewer-Titchener Corp has achieved a rare thing in commercial literature: an authentic historical record that is at the same time a warm and romantic account of an earlier era of engineering innovation.

Documented in this 32-page paper-back history are many reminders of the time, around the turn of the century, when transmission technology was passing through an explosive period of development. As the record begins Edison's Pearl Street Station was in operation. The mounting popularity of electricity is driving voltages up sharply. Transmission lines are outgrowing the capabilities of early glass insulators. Porcelain insulator manufacture is an infant art practiced by manufacturers of chinaware and doorknobs.

By 1893 a new "wet-process" of porcelain manufacture had been perfected that brought not only higher dielectric strength and smooth glazed surfaces, but the end of a plague of porosity problems. By the close of the century wet-process insulators were being made in multipart design much like today's.

But after 1900 demands for electric service were forcing voltages up again—this time beyond the capacity of pin insulators to support the larger conductors required. But the first "under-slung" or "suspension" insulators did not appear till 1903. They were not articulated like today's but rigid. The pin of each unit was integral with the cap of the one below. The popular "Buck-Hewlett" suspension insulator—with flexible connections between units—appeared around 1907.

Connectors and conductor attachments in this early period were improvised from pieces of stranded copper conductor joined by wire rope clips. Typical was one used in 1907 in Michigan on a 110-kv line.

Meanwhile, copper's low tensile strength was becoming a handicap in transmission conductors. The initial answer had been found in aluminum about 1895 but not until about 1910 did ACSR make its appearance, bringing high strength, lightweight and excellent conductivity. With it came not only higher tensions and longer spans, but more problems of conductor suspension.

The BTC history gives close attention to the evolution of conductor suspension hardware, showing a number of the designs that appeared around World War I. Early clamps were often crude and bulky and frequent ACSR failures were attributed to them until industry effort brought improvement in 1920.

Vibration had not been a problem; but about 1925 the increasingly frequent breakage of ACSR began to be attributed to vibration fatigue. Many of the failures were traced to the design of early clamps, it is reported. Toward the end of the 1925-1930 period, however, clamp designs began to yield direct antecedents of today's fittings. Trunnion-type suspension clamps and compression-type strain clamps made their appearances. The first recorded use of aluminum forgings for clamp body construction appeared about this time in a clamp design for the Wallenpaupack-Siegfried line. Aluminum forgings for clamp bodies were to reappear 20 years later as today's clamps.

This period of experimentation and vibration research by 1930 produced two product improvements which have stood the test of time: vibration dampers and armor rods. Here again the BTC history presents the interested reader with a detailed evolution of designs that includes among others the Stockbridge and Tebo dumbell dampers, straight, tapered and preformed armor rods.

The years 1928 and 1929 saw introduction of the first complete line of forged steel transmission clamps designed from field experience and research. Except for the comparatively recent introduction of aluminum clamp bodies, features incorporated in the 1928 designs are accepted today.

The BTC hardware history closes with a chapter on forged clamp improvements which acknowledges the introduction of non-ferrous materials as perhaps the most significant refinement in strain and suspension clamps since 1935. It points to the use of closed-die, heat-treated aluminum-alloy forgings for hi-line fittings as fulfilling all present and foreseeable requirements for the electrical transmission industry in the coming decades.

To the young engineer unfamiliar with the early history of transmission, as well as those more experienced, BTC's "History of Hi-Line Hardware Since 1882" can't fail to bring a stir of pride in past accomplishments and an awareness that the changes that lie ahead will be even more extensive than those which already have been made.

Florida Power Corp.
selects
UNION METAL
H-Frames
for over-water
installation
INSTALLATION DATA
PROJECT: 66-kv line for Florida Power Corporation.
LOCATION: Across Apalachicola Bay.
STRUCTURES: 90-foot galvanized steel Monotube self-supporting H-Frames.
SPACING: 1150 feet.
TOWER DESIGN LOADING: 135 mph hurricane wind conditions, (45 pounds per square foot wind on towers and conductors).
CHIEF TRANSMISSION ENGINEER: C. B. Benham, Florida Power Corp., St. Petersburg, Florida.
If you are not already familiar with the many advantages of Monotube transmission line structure design, an inquiry will bring detailed information.
UNION METAL
Monotube Transmission Line Structures
THE UNION METAL MANUFACTURING COMPANY
Canton 5, Ohio • Brampton, Ontario

Graybar Program Aims at Modern Relighting

A program to bring lighting in commercial and industrial buildings up to modern levels has been instituted by Graybar Electric Co.

To be known as Lighting Action Plan, it was developed after an analysis of lighting deficiencies in commercial and industrial facilities as defined by the Blackwell Report.

In introducing the program, B. F. Benning, Graybar general lamp and lighting sales manager, pointed out that the lighting modernization market represents a potential $5 billions business. The related product market for wiring and accessories is approximately twice that amount, thus it is one of the most dynamic profit markets in the electrical industry, he said.

Benning estimated that the potential for fixture sales alone would amount to about $1 million in relighting for every 25,000 people.

The program has already received the active support of more than 200 electric utilities, plus 12 of the nation's largest lighting fixture manufacturers and electrical contractors.

Field meetings are being set up to bring suppliers together with contractors and utilities to tell them of the program.

Sales training programs, manned by lighting specialists, will provide electrical contractors with information on how to design and sell actual lighting applications.

The LAP program is being introduced nationally by a 1,600 Graybar sales force and marketing manpower of participating manufacturers and utilities.

Utilities have already mailed out 1,200,000 pieces of literature to their customers.

One hundred meetings have been held at the local level with approximately 5,000 contractor and utility personnel in attendance.

Several installations of fixtures have already been completed.

Focal point of the promotion will be a group of materials called "The Graybar Action Plan for Electrical Contractors."

Materials include:

1. Lamp and Lighting Guide and In-Stock Fixture Selector.

2. Literature on all in-stock products available free of charge.

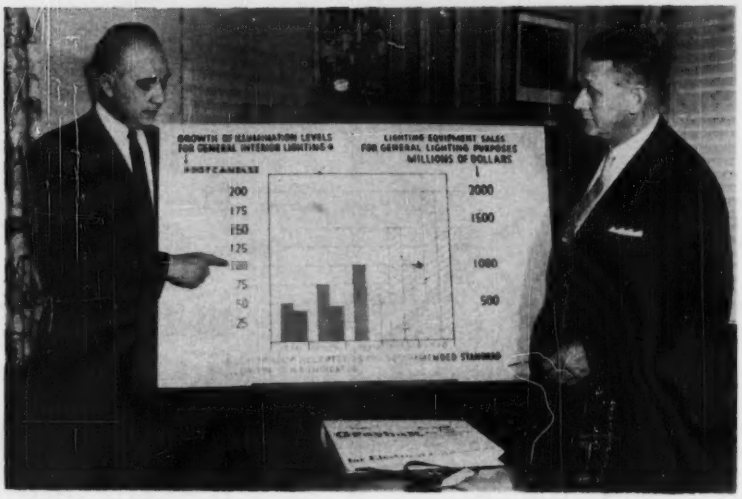
3. Stickers proclaiming "Good Lighting Doesn't Cost—It Pays."

4. A 16-page Direct Mail Lighting Magazine.

5. Lamp plan book to help electrical contractors develop repeat business.

6. Specially designed light meter.

7. Finance plan which allows a contractor to finance the whole job for up to five years.



LIGHTING level increases prompted Graybar to undertake lighting modernization program. B. F. Benning, general lamp and lighting sales manager (left), shows President W. E. Henges how levels have increased in last ten years, their expected increase in 1970 and the relation to lighting equipment sales

TV Personality Sparks CEI Promotion

Cleveland Electric Illuminating Co's Christmas promotion this year combined a plug for electric living with an appearance by a live television personality.

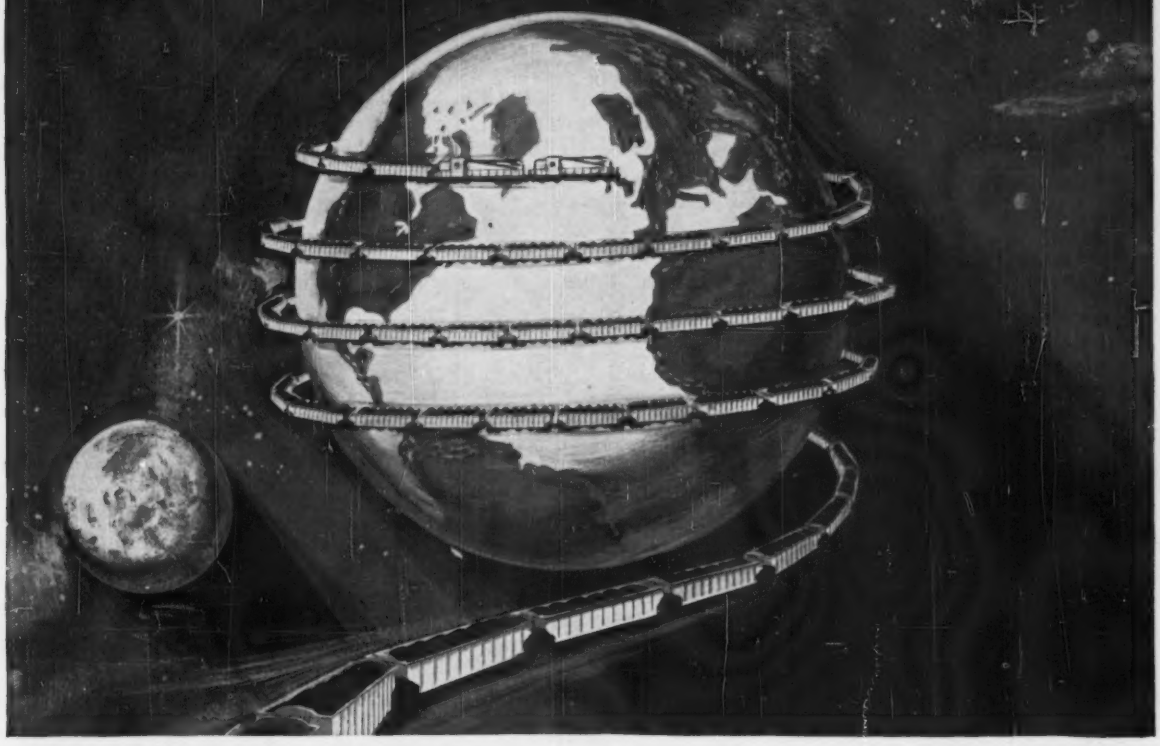
The Christmas display, set up in CEI's first floor demonstration and display room, combined the appearance of local TV personality, Barnaby, with a line up of major and minor electrical appliances.

While hiring a live personality upped display costs 30% over last year it also upped attendance from between 4,000 to 5,000 last year to almost 10,000 this year. Although much of this number were preschool children with whom Barnaby has his greatest audience, they had to bring their parents with them. To get the kids into the programs Barnaby gave at the exhibit, the elders had to pass through a maze of electrical goods—119 pieces of big electrical appliances (freezers, dishwashers, stoves, and refrigerators) and little (frypans, irons, record players, etc). Mimeographed sheets of items with prices were available.

Another plus in this promotion was that CEI got into the *Cleveland Press'* Christmas parade even though commercial firms are not usually allowed to participate.

CEI took 10-second spots on Barnaby's daily show to give the times of his appearances at the exhibit.

PEABODY'S COAL RESERVES
could fill a train long enough to circle the earth eleven times!



This Tremendous Coal Reserve... Over Two Billion Tons ... Is Your Assurance of a Dependable Source of Fuel

Imagine a train 200,000 miles long . . . over 38,000,000 hopper cars filled with coal . . . that's a lot of fuel! In terms of potential power, Peabody's coal reserves could light and power Chicago for 200 years. These vast reserves . . . strategically located near the nation's inland waterways—plus Peabody's efficient mining facilities . . . are your assurance of an economical supply of coal for years to come. And at Peabody's modern, automated Processing Plants, coal is tailor-made to get maximum efficiency from your burning equipment.

Whether you buy a carload or a trainload . . . your business is important to Peabody. Plan now to use this vast fuel reservoir. Call your nearest Peabody Office *today*.

Learn more facts about Peabody Coal . . . its importance to the nation's economy and your business. Send for Peabody's new FREE booklet, "COAL . . . ANCIENT STOREHOUSE OF MODERN LIVING." Write Department EW.

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Central Illinois PS Names Cook VP-Finance

GEORGE R. COOK

George R. Cook has been elected vice president in charge of finance and secretary of Central Illinois Public Service Co, effective Jan. 1, succeeding H. M. Parker who will retire.

C. C. Bredehoft was elected treasurer and assistant secretary and Karl J. Federer was chosen assistant treasurer, with offices in Springfield.

A University of Illinois graduate, Cook joined CIPS in 1929 as an accountant and a traveling auditor. He was named assistant treasurer in 1951, and treasurer seven years later.

Bredehoft has been with CIPS since 1931 as an accountant and a traveling auditor, auditor for the southern division, and most recently as assistant treasurer. Federer joined CIPS in 1938 as an assistant cashier, became bookkeeping supervisor for the southern division, and then auditor for the southern division in 1954.

PERSONAL BRIEFS

Toledo Edison Co has replaced **Irvin H. Heitkamp,** retired, with **Francis A. Liedel** as underground lines engineer.

L. Thomas Leonard has been promoted to site service manager for Jersey Central Power & Light Co and the New Jersey Power & Light Co, and **Frank Misch** was promoted to right-of-way agent.

Joseph L. Williams has been promoted to general division manager of Portland General Electric Co, and **Nile Burman** has succeeded him as superintendent of electrical maintenance and construction.

Albert Bauer has become Pacific Power & Light Co general manager of district service operations in five states. **Harold H. Henninger** became assistant general manager, and the following were made division managers: **Homer Beale,** manager for Oregon division properties outside metropolitan Portland; **D. B. Leonard,** manager for Washington division properties; **Robert R. Gordon,** Idaho and Montana division manager; and **Roy Vernstrom,** Portland, Ore., division manager, while **Veryl N. Hoover** continues as Wyoming division manager. Since Vernstrom is planning to leave PP&L soon, **Orren W. Brownson,** assistant vice president in charge of the rate department, has been appointed his successor.

Philadelphia Electric Co has appointed **Edward B. Myers Jr** manager of the rate and standard practice division, and **Robert F. Gilkeson** manager of the newly-created engineering and research department. Others named to the department were **A. H. Kidder,** assistant to the vice president; **J. L. Everett III,** director of research; **C. W. Bary,** director of economic and rate analysis; and **J. A. Thielman,** assistant director, economic and rate analysis. Also, **John L. Hankins** became superintendent of Eddystone station, and **Shields L. Daltroff** assistant superintendent. **T. S. Fetter Jr** was named assistant to the president.

Seattle City Light Co has named **C. L. Bradeen** to succeed **Rhodes V. Spencer** who retired as power operations engineer.

V. A. Shriner Jr has been appointed district engineer of Virginia Electric & Power Co's Alleghany district at Clifton Forge, succeeding **M. J. Swaim** who became district supervisor at VEPCO's Portsmouth office.

A. L. Zimmer has retired as rural electrification supervisor for Empire District Electric Co in Missouri.

Harold L. Russell has been appointed general sales manager of the Weston Division of Daystrom, Inc.

At Westinghouse Electric Corp, the following promotions have been made: **W. J. Delaney Jr** to operations manager of the major appliance division; **George B. Saviers** to manager of special products group of the lamp division; and **John E. Noren Jr** to San Francisco district manager for the elevator division. **Dr Kuan H. Sun,** manager of Westinghouse's radiation and nucleonics laboratory, has been given the 1960 Achievement Award of the Chinese Institute of Engineers of New York.

General Motors has promoted **Robert L. Pancoast** from assistant comptroller to comptroller of the Electro-Motive Division. He succeeds **Guy D. Briggs Jr,** who was promoted to a post in GM's overseas operations division.

Copperweld Steel Co's wire & cable division chief electrical engineer, **Claude H. Jensen,** has retired.

Leonard B. Mackey has joined International Telephone & Telegraph Corp as assistant director of the patent contract department. And,

(*Continued on page* 94)

Distribution costs greatly reduced by EBASCO planning

Wherever Utility Companies have called on EBASCO engineers for help in planning expansion or reconstruction of distribution systems . . . costs have been reduced, efficiency materially increased.

How does *your* system look in terms of present needs? Of future requirements?

EBASCO offers you long-range *or* interim planning services based on over 50 years' experience in finding economical solutions to the problems of the electric utility industry. EBASCO analyzes your system minutely, starting with customers and load growth. EBASCO engineers make their recommendations—based on practical world-wide experience—as to voltages, service continuity, and location and capacity of substations and circuits. Their thorough knowledge of methods and equipment provides invaluable assistance in comparing investment and operating costs.

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Our brochures describe EBASCO's services and how they may be of use to you. For copies, write Ebasco Services Incorporated, Dept. M, Two Rector Street, New York 6, N. Y.

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When you select a size and grade of strand for a specific job you want to know that it meets every requirement of that job. You want ample strength to sustain the ultimate load—plus an adequate safety factor. You want pliability for ease of working in the field. You want ruggedness to withstand the abuse which may be encountered during and after installation. You want long, dependable life. And, you want reasonably low first cost and low maintenance costs.

For more than 50 years *Crapo* Galvanized Steel Strand has consistently demonstrated its ability to more than meet all of these requirements. Proof of its reliable performance is to be found in the case histories of overhead power and communication lines throughout the country.

Crapo Galvanized Steel Strand is fully protected against corrosion by heavy, uniform, dense coatings of commercially pure zinc tightly bonded to the individual wires. All grades and sizes are available in A, B and C weights of coating.

For details, ask our distributor or write direct!

INDIANA
STEEL & WIRE
COMPANY, INC.
Muncie, Indiana

in ITT's Kellogg Division communications systems department, **Hugh J. Tremblay** has been boosted to manager of marketing and sales.

The newly-created post of manager of Aluminum Co of America's development division has been filled by **William R. Butler.** Named to posts as development managers were: **L. M. Dunn,** building products and structures; **D. P. Kennedy,** consumer durable goods; **Edward T. Wanderer,** machinery and equipment; **Howard H. Nuernberger,** transportation; **E. H. Spuhler,** aerospace and military; and **Harry W. Fritts,** containers and packaging.

General Electric Co has formed a signal diode project within its semiconductor products department, with **James H. Sweeney** as project manager and **Hugh R. Lowry** as manager of signal diode engineering. **Walter N. Shambach** became manager of marketing and product development in the heaters and devices section of GE's industrial heating department and **Marshall Anderson** became manager of manufacturing in the general purpose control department. **Charles G. Klock** was named to the board of GE Credit Corp, a GE subsidiary, and became president and general manager, succeeding **George F. Mosher** who resigned. Mosher will continue as a director and will serve as a consultant.

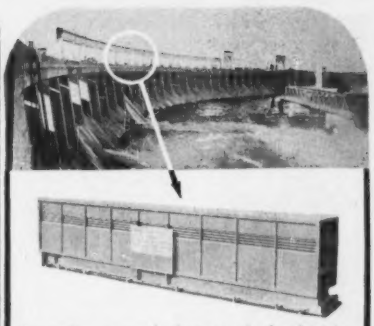
Cutler-Hammer staff sales consultant **Elmer G. Peterson** has retired.

J. R. COFFIN

Coffin Elected President Of Jackson & Moreland

John R. Coffin has been named president of Jackson & Moreland, Inc, Boston consulting engineers.

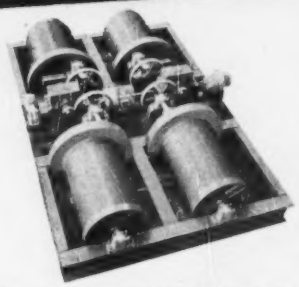
A Harvard graduate with a BS in electrical engineering from Massachusetts Institute of Technology,



For the second largest hydroelectric power plant in the United States at Massena, New York—as part of the St. Lawrence power project—Uhl, Hall & Rich, project engineers, selected MURCO Gate Hoists to control the water level at Long Sault Dam. Each hoist weighs 93,000 lbs. . . . overall length 57 feet, 8½ feet wide, 12½ feet high . . . lifting capacity of 175 tons and will raise and lower the gates in a dam at a speed of 1 foot per minute.

MURCO
GATE HOISTS
. . . FOR ANY SIZE POWER DAM

MURCO Gate Hoists are designed and made for any size power dam . . . capacities from less than 1 ton to over 375 tons . . . from the smallest hand operated to the largest motor operated gate hoist, all made to specifications.



One of the two 380-ton MURCO Gate Hoists furnished to the Power Authority of the State of New York.

Each hoist operates a gate 46' wide by 67' high at one foot per minute. These gates divert the water from the Niagara River above the Falls into covered conduits five miles long. The two conduits bring the water to the Niagara Generating Plant on the United States side of the Falls.

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Coffin came to Jackson & Moreland in 1921 as an engineer. He became a junior partner in 1943, vice president in 1956, and, before his promotion, was senior vice president.

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Two Promoted by Southern States Equipment Corp

Southern States Equipment Corp has promoted H. C. Anderson to sales manager-protective equipment, and John M. Tomme to sales manager-power switching equipment.

Anderson, a Georgia Tech graduate, has been with Southern States since 1946. He has held posts as chief inspector, Western district manager, and assistant sales manager.

Tomme, also a Georgia Tech graduate, has been with the company since 1953 and has been field engineer, district representative, and regional manager.

OBITUARIES

Merville R. Kromer, 62, general superintendent, Northern States Power Co . . . **M. R. Howard,** 82, founder of the first electric power station in Harlan, Ky., which was later sold to Kentucky Utilities Co . . . **John Tanty,** 65, secretary, Clintonville, Wis., Water & Light Commission . . . **W. Nelson Smith,** 92, engineer involved in numerous railroad electrification projects in the Northwest and Canada . . . **Ernest E. Robinson,** 69, director of Tennessee Valley Authority's power production office . . . **Joseph S. Bowman,** 73, formerly with Westinghouse Electric Corp and most recently with American Smelting & Refining Co . . . **Col Nelson P. Jackson,** 49, director of government relations, and **Roger F. Bell,** 23, employee, both of Joy Manufacturing Co . . . **J. Gabriel Delozier,** retired engineer, Philadelphia Electric Co.

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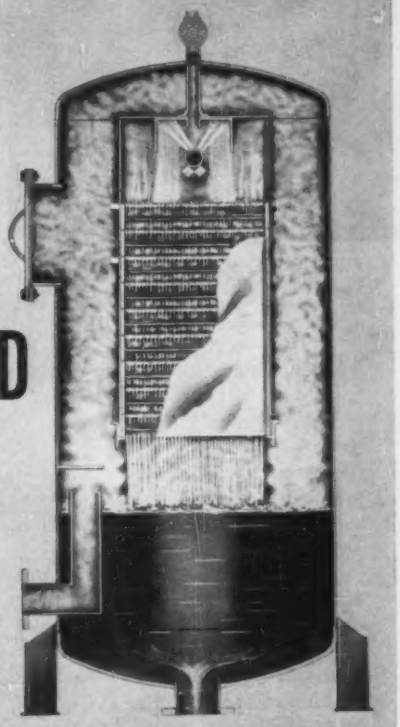

The picture above illustrates the new Permutit Tray Deaerator, which is *guaranteed* to reduce oxygen to .005 ml/l, or less, and to remove all the free CO_2.

This sectioned illustration shows the stainless steel trays and inner chamber. Steam passes upward through them, while the water spills down from tier to tier, constantly being exposed to the steam until, fully deaerated, it reaches the reservoir at the bottom.

The highest temperature incoming steam contacts this final deaerated water. It is also the purest, oxygen-free steam, and as it sweeps upward it takes to the vent all the freed corrosive gases.

The highly efficient internal vent condenser saves B.T.U.'s by reducing vented steam to a negligible wisp which is just enough to carry off all the non-condensable gases.

Guaranteed Water

These and the other design aspects of the Permutit Tray Deaerator enable us to give you a *guarantee* that you'll always get feedwater with (a) less than .005 ml of oxygen per liter of water, and (b) no titratable free CO_2.

And just off the presses is our Bulletin 4732, containing information on the construction details, operation, and other advantages of the Permutit Tray Deaerator. Send for a copy.

Permutit Division, Dept. EW-120, 50 West 44th Street, New York 36, N. Y. In Canada, The Permutit Company of Canada, Ltd., 207 Queen's Quay West, Toronto 1, Ontario.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

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POWER FLOW is calculated by C. C. MacArthur of Pennsylvania P&L

AIEE Told of Computer Progress (*Continued from page* 49)

and operation of existing units at minimum cost were explored in a group of papers. Fuel and investment costs for future systems are determined with a two-in-one program for a medium-sized computer, said L. W. Coombe and W. J. Pfeifer Jr, Detroit Edison Co.

They presented a computer program which is a simplified approach to the simulation of generator loading for various schedules of future additions. Time to run a fuel cost problem ranges from 30 to 100 min for a 35-year study involving 40 to 45 units. The investment cost program takes about 30 sec for a 35-year study of 20-unit additions.

Economic dispatch of generation directly from power system voltages and admittances can be handled in a method using the fundamental equations for power flow and the Lagrange minimizing method. This approach, said R. B. Squires, Westinghouse, is more accurate at all load levels because it calculates directly from the network constants, rather than from a loss formula or variable B constants. No restrictions are placed upon voltage magnitudes or angles in the network, except the use of constant real voltage at generators. This is a condition conforming to the usual operation of the system.

Squires said an application of the method to network of 19 buses produced a total fuel input cost less than that produced by the B constant method. Answering questions, he pointed out that this method gives the often applied correction of raising bus voltage to compensate for heavy system loads. Voltages held at the generator bus determine the voltage on the system. He concluded that the method actually combines load-flow with system economics in one package.

If for a given hour a certain combination of units is selected as the least costly to operate, what is the least costly combination in the preceding hour? Answer to this question by dynamic programing on a large computer was presented by W. H. Osterle and J. Geiser, of West Penn Power Co, and K. M. Dale and C. A. DeSalvo, Westinghouse. Their approach selects the best combination of units to be operated and economically dispatched for each day to meet the day's load at minimum cost, including system losses, production fuel, and start-up fuel.

The authors reported that for a model power system of 16 units totaling 1,642-Mw capacity (using units from the West Penn Electric system), the dynamic programing method showed a production cost lower than that of the shut-down rule-of-thumb method, or an indicated saving of $200 per day. On the actual West Penn system, however, the potential saving would be greatest over the week-end when a high load factor almost dictates what units must be scheduled. Questioned as to whether dynamic programing would preclude an on-line dispatch computer, the authors reported that, if savings may be taken as a function of system size, an on-line unit would be justified.

Discusses Scheduling

Preparation of generating schedules in advance, even if adequate for a particular system, is only an interim measure, said P. G. Lubisich, Los Angeles Dept of Water & Power. The need to operate a system for a large part of the time with unpredictable combinations of units in service makes it desirable to eliminate advance scheduling, he said.

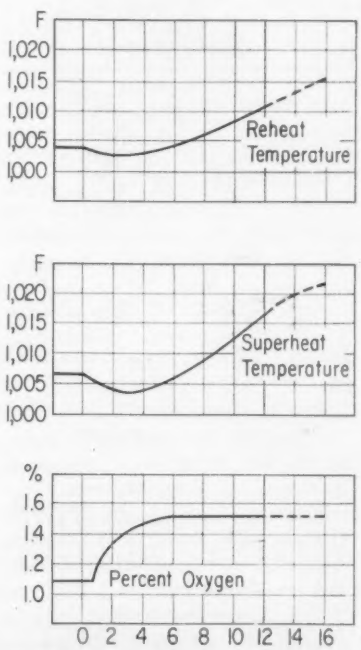
Prerequisites to insure compatibility of process and controls for complete power plant automation are a complete analysis of system dynamics and an accurate and reliable analog model of the plant. To these ends, transient response tests were made on Unit 6 at Sterlington Station of Louisiana Power & Light Co before design of the automation system for Little Gypsy Station. Details of these tests were reported by B. H. Baldridge and N. L. Dickinson, Daystrom, Inc, and C. L. Denson, Louisiana P&L.

Using an open-loop response test procedure, tests were made for each of nine variable inputs at each of five loads from 20 to 100%, with 43 runs in all. Results of some runs are shown in an accompanying illustration. After reduction of digital data to analog curve form, the transfer function between each input and output variable was established. Analog computer circuits were designed to represent each transfer function. Total effect of all inputs was summed by superposition to develop the analog model.

Effects of regulator, exciter, and governor responses are desirable and necessary refinements in a digital computer study of transient stability. How these effects are included in a computer program was presented by M. S. Dyrkacz, C. C. Young, and F. J. Maginniss, all of GE. The new program includes six major changes in the calculating procedure.

Certain additions in the program output include current magnitude and apparent impedance looking

(*Continued on page* 98)



RESPONSES to output variables in fuel input shown for Sterlington Station

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Registration of Contractors

The Commission intend to make substantial extensions to the existing Power Station in Port-of-Spain. The civil engineering works will be executed by a fixed rate type contract and it is expected that the works will begin in the first half of 1961.

The major civil engineering works will include:—

1. Steel framed structure
2. Foundations for buildings, boilers and turbo alternators
3. Cooling water culverts and drain
4. Pumping station
5. Associated and miscellaneous building work

The approximate estimated cost of these works is W.I. $5 million (W.I. $4.80 = £1).

Application for Registration Forms should be made to the Consulting Engineers to the Commission, Howard Humphreys & Sons, Standard Life Building, 1 Edward Street, Port-of-Spain, or to their London Office, 8 Francis Street, Westminster, London S.W.1. The closing date for the issue of Registration Forms is 21st. January, 1961.

Completed Registration Forms should be forwarded in accordance with instructions contained therein to:—

The General Manager
TRINIDAD & TOBAGO ELECTRICITY COMMISSION,
P. O. Box 121, Port-of-Spain, Trinidad, W. I.

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Utility Electrical Engineer—for administrative headquarters of nationwide utility; must have E.E. degree, preferably with an additional business or advanced engineering degree. A minimum of 8 years of engineering, operating and administrative experience is required. Age 30-45. Salary open. Send resume of background and qualifications to: D. Olshansky, Citizens Utilities Company, Ridgeway Center, Stamford, Connecticut.

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AIEE Told of Computer Progress (*Continued from page 96*)

into any of 25 selected lines, except transformers; power flow in selected lines; components of voltage at each bus; and magnitudes of field flux linkages, field voltage and input torque for generators where voltage regulator response is represented.

Discussion emphasized the need for additional refinements in computer stability studies, including exciter ceiling voltage, short-time thermal ratings, regulation, the probability of tie-line overloads, and effects of relay operation.

S. G. Vassiliev, American Electric Power Service Corp, said that the program's refinements come when system planners can afford less than ever to overdesign bulk power systems to carry power from remote stations. To illustrate proper design, he said that evaluation was made of the effect of faster exciter response on the transient stability margin of the 475-Mw Breed Plant tied by a 200-mile, two-circuit, 345-kv line to the load center. As a result, an exciter response ratio of 2.0 pu, rather than the standard 0.5 pu, permitted the critical switching time for a 3-phase fault near the 345-kv Breed bus to be improved from 4.4 to 5.5 cycles.

A new program, based on the Z-matrix, determines power flows for a multi-generator system using a modified dc board approach. In this presentation, H. E. Brown and C. E. Person, of Commonwealth Edison, said that long-range system planning in which consideration of random emergency conditions requires a multiplicity of power flow studies is more practical with the new program. The method requires only slight modifications to the matrix for each system change and produces a definitive solution for network.

A computer program that automatically searches for weak links in a transmission network was described by C. C. MacArthur, Pennsylvania Power & Light Co. This method extends load-flow studies by looking for overloaded circuits upon the loss of one or more major transmission links and readjusts the interchange among areas until power transmitted is maximized.

Superposition of adjusted power flow on basic normal power flow studies is done through distribution factors of two types: Power flow for changes in generation, and redistribution of power flow for circuit outages. The program in Fortran has been processed on an IBM 704 8K computer. For a system with 38 lines, 21 generators, and 14 outages, seven multiple, a single run took about 10 min. Load flow studies to check the calculated limitations at one or two points showed excellent agreement.

A method for rapid calculation of certain transmission line constants, using fairly simple data preparation, was detailed by N. Savage, Detroit Edison. The programs compute zero sequence and positive sequence impedances per phase; total 3-phase positive sequence charging kva at 120 kv; and, zero sequence mutual impedance between two transmission circuits on a single tower.

Letters (*Continued from page 5*)

area, without cost to the applicant, in any amount and promptly.

Giving the best of service, almost free of outage when under our control, with a minimum of 115 volts at any meter. By so placing servicemen and proper equipment, to insure an outage should be held to minutes.

Payment promptly of interest on our loan and to maintain proper reserves to insure this payment.

Advance payment on our loan, to insure sound operation regardless of conditions that may develop.

Investment reserve that will enable us to maintain sound operation regardless of any events beyond our control.

To continue to lower rates. (Power Co's average was 5.2¢ for residential in the towns they served in 1939; our average was 2.9¢ in 1940 and the present average is 1.2¢—a spread of about seven mills from our station cost.)

To always serve this area, regardless of conditions of pressure.

To have as many plant additions as possible financed with our funds. However, 2% loan funds are required for area coverage, to which we are committed.

To always be ahead of load growth in our service area. This is done by purchasing only 10, 25, 50 and 100, etc. kva transformers and, where indicated, using 3/0 ACSR, double circuit, regulated. Our area is such that looped 3-phase circuits are used.

With both our positions clear, we can continue to use the valuable articles and information in *Electrical World*.

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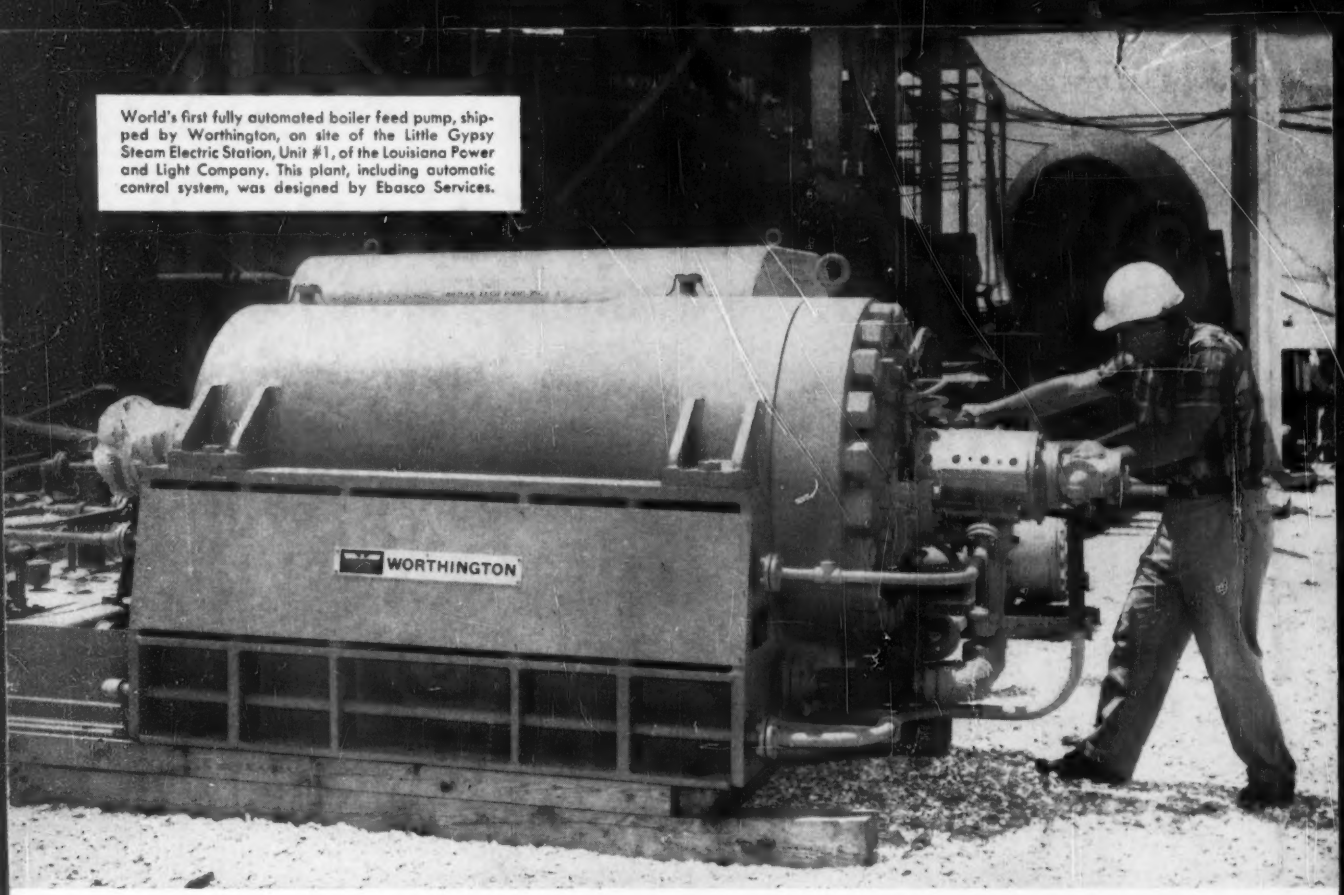

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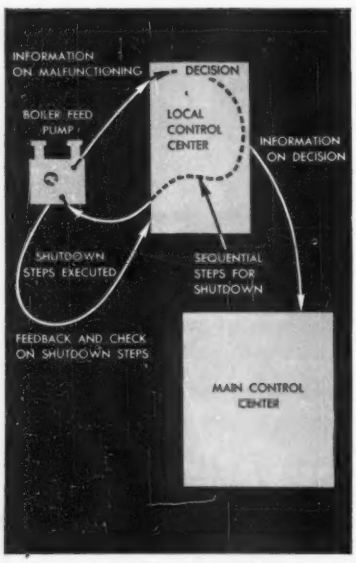

Automatic decisions for load variation: routine or emergency shut-down can be locally or remotely instrumented.

Frankly, we don't know. We do know, however, that we've shipped the first high-pressure boiler feed pump for a fully automated installation. Thus the "full automation" question looms bigger with each new plant.

What do we mean by "full automation," when important components have been automatically controlled for many years? We mean the use of improved equipment and instrument design and control techniques—plus modern data processing systems—in such a way that the power plant will operate continuously at optimum efficiency under varying loads, starting and stopping units as required with maximum equipment protection.

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